CIMRON

A DIVISION OF LEAR SIEGLER, INC.

SERIES 7000A DIGITAL VOLT AND VOLT RATIO METERS INSTRUCTION MANUAL

SERIES 7000A
DIGITAL VOLT AND
VOLT RATIO METERS
INSTRUCTION MANUAL

All references to "Cimron" or "Cimron Corporation" shall hereinafter refer to Cimron Division, Lear Siegler, Inc.

CIMRON
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CIMRON
PACIFIC
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MORENA BLVD. SAN DIEGO, CALIFORNIA 92110 A.C. 714 • 276-3200

y 13, 1965 FIELD SERVICE BULLETIN Issue 112

All Customers with Series 7000A Instruments.

truments Affected: Digital Voltmeters of Series 7200A and 7400A, and Digital Volt-Ratio Meters of Series 7300A and 7500A.

ason for Issuance: Change in Reference Assembly

cion Required: Note for maintenance and part replacement information.

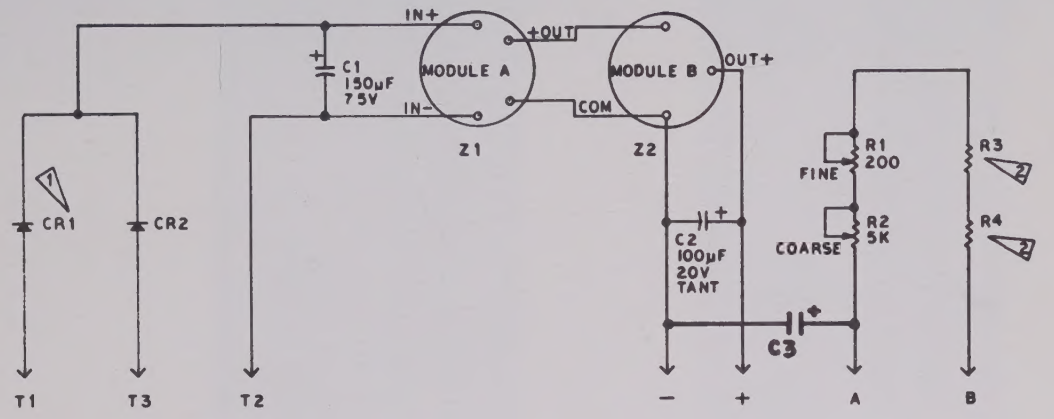
nron REFERENCE ASSEMBLY 70-6111 is a direct replacement for Cimron REFERENCE ASSEMBLY -6011-3. The replacement assembly is shown in schematic 70-0811. The input at T1 and T3 is rec- ed and filtered in diodes CR1, CR2, and capacitor C1. The input to the pre-regulator Module A is V DC ±10%. Module B contains the final reference element. The reference output voltage ranges are ed in Note 2 of the schematic. Module A and Module B are a matched pair, with the same serial nber on each Module.

PARTS LIST

SEMBLY: Reference CIMRON PART NO. 70-6111

HEMATIC SIGNATION	DESCRIPTION	CIMRON PART NO.
	CAPACITOR, ELECT, 150 uf, 75V	1-57271
	CAPACITOR, TANT, 100 uf, 20%, 20V	1-57103
	RESISTOR, VAR TRIM WW 200Ω, 1/4W	7-54215
	RESISTOR, VAR TRIM WW 5KΩ, 1/4W	7-54207
, R4,	FACTORY SELECTED VALUE	
1, CR2	SEMICOND DIODE DI42S SC-2	7-95502
	REFERENCE MOD A	90-0509-1
	REFERENCE MOD B	90-0509-3

Donald C. Meyer
Customer Service Supervisor



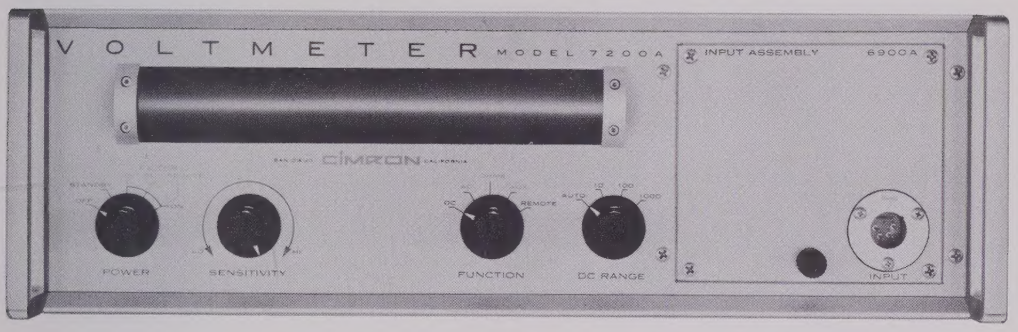
70-0811
REL DATE 5-26-66

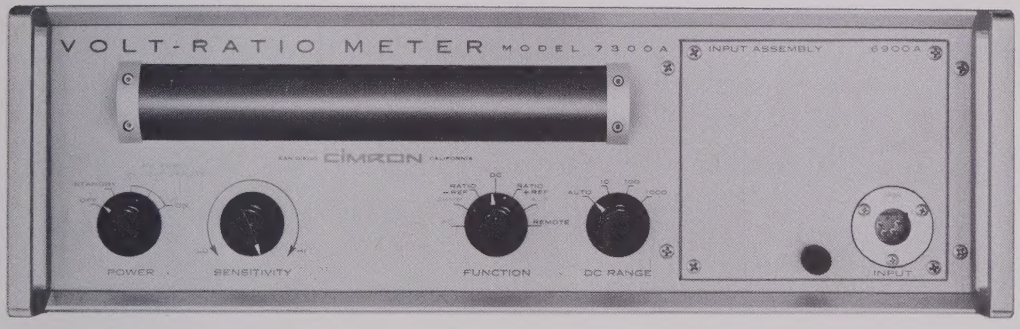
NOTES ◇

1. PARTIAL REFERENCE DESIGNATIONS SHOWN. ALL NUMBERS ARE IN THE SERIES 1101 & ON. EXAMPLE: CR1 IS CR1101, ETC.
2. RESISTANCE VALUES OF R1103 & R1104 ARE SELECTED RELATIVE TO THE OUTPUT VOLTAGE OF MODULE "B" — SEE TABLE.

OUTPUT VOLTAGE OF Z1102	RESISTOR VALUES	
	R1103	R1104
11.90–12.10	10K	7.5K
12.10–12.40	10K	10K
12.40–12.60	20K	2K
12.60–12.90	20K	5K
12.90–13.23	20K	7.5K

DRAWING SIZE C	SCHEMATIC — REFERENCE ASSY 70-6111						CIMRON CORPORATION		
	DESIGN								
	CHECK	T. Smith	7/6	CHF ENG	R.O.L.	7/6	70-0811		REV
7000 SERIES	DRAFT	Fiske	7/6	PROJECT	L. Reed	7/6			
MODEL		APPD	DATE		APPD	DATE	SCALE NONE	SHEET 1 OF 1	


VOLTMETER MODEL 7200A
INPUT ASSEMBLY 6900A
CIMRON
POWER
SENSITIVITY
FUNCTION
DC RANGE
INPUT


VOLT-RATIO METER MODEL 7300A
INPUT ASSEMBLY 6900A
CIMRON
POWER
SENSITIVITY
FUNCTION
DC RANGE
INPUT

VOLTMETER
POWER
SENSITIVITY
PRINT CONTROL
FUNCTION
DC RANGE

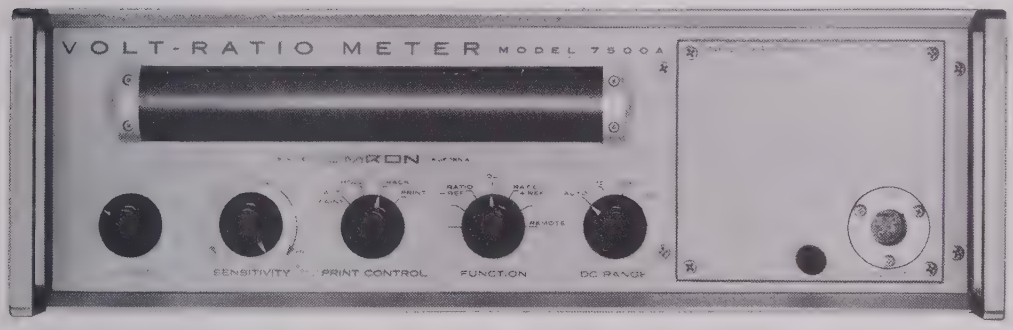

VOLT-RATIO METER MODEL 7500A
SENSITIVITY
PRINT CONTROL
FUNCTION
DC RANGE

TABLE OF CONTENTS

SECTION		PAGE
I	INTRODUCTION	1-1
II	SPECIFICATIONS	2-1
III	PRELIMINARY INSPECTION AND OPERATION	3-1
IV	CALIBRATION AND SPECIFICATION VALIDATION	4-1
V	THEORY OF OPERATION	5-1
VI	MAINTENANCE	6-1
VII	RECOMMENDED SPARE PARTS	7-1
VIII	ACCESSORIES	8-1

LIST OF TABLES

Table	Title	Page
1-1	Series 7000A Basic Instruments	1-1
3-1	Front Panel Controls, Series 7000A Volt and Volt-Ratio Meters	3-3
5-1	Count Sequence and Binary Conditions	5-8
5-2	Counting Logic With Polarity Change	5-12
5-3	Counting Logic for Small Voltage Change	5-13
7-1	Recommended Spare Parts	7-1
7-2	Test and Extension Board Assemblies	7-2

LIST OF ILLUSTRATIONS

Figure	Title	Page
2-1	Dimensions, Front and Top, Series 7000A	2-3
2-2	Dimensions, Rear Panel, Models 7200A and 7300A	2-4
2-3	Dimensions, Rear Panel, Models 7400A and 7500A	2-5
2-4	Rear Panel Model 7200A and 7300A, Rear Panel Model 7400A and 7500A	2-6
3-1	Voltmeter Input Leads and Grounding Connections	3-2
4-1	Gate/Error Signals	4-2
4-2	Internal Adjustments	4-3
4-3	Test Setup - Ratio	4-5
4-4	Test Setup - Input Impedance	4-6
4-5	Test Setup - AC Common Mode	4-7
4-6	Test Setup - DC Common Mode	4-8
5-1	Potentiometer Nulling Arrangement	5-1
5-2	Simplified Block Diagram of Voltmeter Closed Loop Servo System	5-2
5-3	Block Diagram, Series 7000A	5-3
5-4	Wolff-Cooper Potentiometer	5-4
5-5	Logic Representation of Down Range Control	5-10
6-1	Top View Showing Plug-in Board Location	6-3
6-2	Bottom View Showing Test Points	6-4
6-3	Power Supply Assembly	6-6
6-4	Reference Assembly	6-10
6-5	Attenuator and Preamp Assembly	6-14
6-6	Amplifier Assembly	6-18
6-7	Logic Driver Assembly	6-22
6-8	Logic Matrix Assembly	6-26
6-9	Units Through 1K Decade Assembly	6-30
6-10	10K Decade Assembly	6-34
6-11	Range and Polarity Assembly	6-38
6-12	"A" Potentiometer Assembly	6-42

LIST OF ILLUSTRATIONS (CONT'D)

Figure	Title	Page
6-13	"B" Potentiometer Assembly	6-46
6-14	Remote Function Assembly	6-50
6-15	Print Control Assembly	6-54
6-16	Down Range Control Assembly	6-58
8-1	Plug-in Capability	8-1
8-2	AC-DC Converter	8-2
8-3	DC Preamplifier	8-3
8-4	Ohms-DC Converter	8-4
8-5	DC Stable Source	8-5
8-6	High Voltage Module	8-6

LIST OF SCHEMATICS

Schematic	Title	Page
70-0704	Power Supply Assembly and Associated Circuits	6-7
70-0711-3	Reference Assembly	6-11
70-0706	Attenuator and Preamp Assembly	6-15
70-0709	Amplifier Assembly	6-19
70-0708	Logic Driver Assembly	6-23
70-0701	Logic Matrix Assembly	6-27
70-0702	Units Through 1K Decade Assembly	6-31
70-0703	10K Decade Assembly	6-35
70-0707	Range and Polarity Assembly	6-39
70-0712	"A" Potentiometer Assembly	6-43
70-0713	"B" Potentiometer Assembly	6-47
70-0710	Remote Function Assembly Used With Models 7200A and 7400A	6-51
70-0705	Remote Function Assembly Used With Models 7300A and 7500A	6-51
70-0714	Print Control Assembly Used With Models 7400A and 7500A	6-55
70-0721	Down Range Control Assembly	6-59
70-0725	Front Panel Controls	6-61
70-0726	Numerical Neon Readout	6-63
70-0727	Signal Circuits, Models 7200A and 7300A	6-64
70-0759	Signal Circuits, Models 7400A and 7500A	6-65
70-0729	Printer Circuitry	6-66

LIST OF EFFECTIVE PAGES

Page Numbers	Issue
i	3/16/64
ii through iii	12/3/64
iv	3/16/64
v through vii	12/3/64
1-1 through 1-2	3/16/64
2-1 through 2-5	3/16/64
2-6	12/3/64
3-1 through 3-4	12/3/64
4-1	12/3/64
4-2 through 4-4	3/16/64
4-5 through 4-6	12/3/64
4-7 through 4-8	3/16/64
5-1 through 5-3	3/16/64
5-4 through 5-7	12/3/64
5-8	3/16/64
5-9 through 5-11	12/3/64
5-12	3/16/64
5-13	12/3/64
6-1 through 6-5	3/16/64
6-6 through 6-8	12/3/64
6-9 through 6-10	3/16/64
6-11 through 6-12	12/3/64
6-13 through 6-15	3/16/64
6-16	12/3/64
6-17	3/16/64
6-18 through 6-20	12/3/64
6-21 through 6-22	3/16/64
6-23	12/3/64
6-24 through 6-38	3/16/64
6-39 through 6-40	12/3/64
6-41 through 6-49	3/16/64
6-50 through 6-52	12/3/64
6-53 through 6-54	3/16/64
6-55 through 6-56	12/3/64
6-57 through 6-59	3/16/64
6-60 through 6-63	12/3/64
6-64 through 6-66	3/16/64
7-1	3/16/64
7-2	12/3/64
8-1 through 8-6	3/16/64
A-1	12/3/64

SECTION I

GENERAL

TABLE OF CONTENTS

Paragraph	Page
INTRODUCTION	1-1
DESCRIPTION	1-1
RATIO MODELS	1-2
PLUG-IN MODULES	1-2
EASE OF MAINTENANCE	1-2

INTRODUCTION

This manual contains complete operations, calibration and maintenance instructions for the Series 7000A Digital Volt and Volt-Ratio Meters and their accessories. Section I contains a general description of the instruments and their capabilities.

DESCRIPTION

The CIMRON Series 7000A instruments consist of four five-digit precision DC voltmeters, each designed to fulfill specific requirements. All 7000A models will range either manually or automatically and will automatically indicate polarity. Models 7300A and 7500A incorporate provisions for DC ratio measuring. Models 7400A and 7500A provide printout connections. Table 1-1 illustrates a comparison of models.

The instruments will measure voltages from 0.0000 to ±999.99 volts and display the measured data including voltage, range and polarity on front panel indicators of the neon type.

The design of the instrument allows it to track an input signal, thereby continuously indicating the voltage present at its input. Changes that occur in the input voltage are followed digit for digit within the limits of the tracking speed of the instrument. The logic circuitry of the instrument samples the input signal approximately 180 times a second providing an average reading rate of greater than 3 readings per second.

Table 1-1. Series 7000A Basic Instruments.

MODEL	POLARITY	RANGING	DC RATIO	PRINTOUT CONNECTION
7200A	Automatic	Automatic	No	No
7300A	Automatic	Automatic	Yes	No
7400A	Automatic	Automatic	No	Yes
7500A	Automatic	Automatic	Yes	Yes

When the input signal changes a large amount the tracking mode of the instrument changes to a logic which more rapidly spans large increments of voltage. This faster logic is used until the instrument approaches null when the tracking mode of operation is resumed.

The Series 7000A instruments are of solid state circuitry throughout and as a result have no problem of heat dissipation. No fans or louvres are required, permitting a tightly closed cabinet which reduces dust and humidity considerations. All instruments in the series employ a floating input to allow bipolar operation and high common mode rejection. On 7400A and 7500A Models the input signal is isolated from the printout contact closures.

RATIO MODELS

The Model 7300A and 7500A Digital Voltmeters incorporate a voltage ratio measurement capability. When this mode of operation is selected by the operating controls, the instrument will display the ratio of the input signal with an externally supplied reference voltage as the quotient of A over B. The external reference voltage may be any value from less than ±1.0 volts to ±100.00 volts DC.

PLUG-IN MODULES

The versatility of the Series 7000A instruments is extended by a design feature which permits the accommodation of plug-in input assemblies. These assemblies allow:

1. AC voltage measurements from 10 microvolts to 999.99 volts.
2. Resistance measurements from 10 milliohms to 9.9999 megohms.
3. DC voltage measurements from 0 to 7.5 kilovolts.
4. DC voltage measurements from 0 to 9.9999 millivolts.

Each of these assemblies are solid state circuitry and may be inserted directly into the voltmeter through the front panel and require no modification of either equipment. Power requirements of the plug-in assemblies is 117V AC and this is supplied internally by the voltmeter when the assembly is in place.

EASE OF MAINTENANCE

Plug-in printed circuit boards are used throughout in the Series 7000A voltmeter construction. This insures ease in maintenance and troubleshooting routines.

SECTION II

SPECIFICATIONS

TABLE OF CONTENTS

Paragraph	Page
DIGITAL VOLTMETER	2-1
DIGITAL RATIO OPERATION	2-2
GENERAL	2-2

DIGITAL VOLTMETER

VOLTAGE RANGE	0.0000 to ±999.99 volts DC in 3 ranges of ±9.9999, ±99.999 and ±999.99 volts full scale.
RANGE AND POLARITY SELECTION	Automatic plus manual front panel range control.
SENSITIVITY	0.001% of full scale (100 microvolts on the 10V range), with Auto Gain 0.003% of reading.
ACCURACY	Within 0.01% of reading ±1 digit for at least 90 days after calibration at constant ambient temperature. Temperature coefficient ±0.001% per degree C°, typically ±0.0005% per degree C°. Maximum rate of change should not exceed 10 degrees C° per hour.
INPUT RESISTANCE	In excess of 1,000 megohms at balance on the 9.9999 volt range; greater than 10 megohms independent of balance on the 99.999 and the 999.99 volt ranges.
BALANCING TIME	Without filter, maximum balancing time with range and polarity changes is 0.9 second. Maximum balancing time without range or polarity change is 0.6 second. Minimum balancing time is under 7 milliseconds; clock rate is approximately 180 per second. With filter, balancing times are increased by a factor of 2 to 3.

COMMON MODE REJECTION	120 db at DC and 100 db at 60 cps with maximum source unbalance of 1000Ω in input high and 100Ω in input low. The input may be floated up to 500 volts DC or peak AC.

DIGITAL RATIO OPERATION (Models 7300A and 7500A only)

RANGE	.00000:1 to .99999:1 direct reading. 9.9999:1 and 99.999:1 can be measured by calculating the correct position of the fixed decimal when manual range selection is used.
ACCURACY (external reference of 10V or greater)	Within 0.005% of reading ±2 digits.
EXTERNAL REFERENCE RANGE	Less than ±1 volt DC to ±100 volts DC.
INPUT RESISTANCE FOR RATIO INPUT	In excess of 1000 megohms at balance on the .99999:1 range; greater than 10 megohms on the 9.9999:1 and 99.999:1 ranges.
INPUT RESISTANCE FOR EXTERNAL REFERENCE	100,000 ohms.
POLARITY	Bi-polar; + signal to + reference or - signal to - reference.
RESOLUTION (digits)	10/(reference voltage) or 0.005% of reading or 1 digit whichever is greatest.

GENERAL

PRINT OUTPUT (Models 7400A and 7500A only)	The instrument provides print output information in the form of 10 line decimal code. The information is furnished through contact closure and is isolated from signal common and case ground.
POWER REQUIREMENTS	115 volts ±10% AC, 50 to 400 cps, approximately 35 VA.
OPERATING TEMPERATURE RANGE	0° to +45°C.

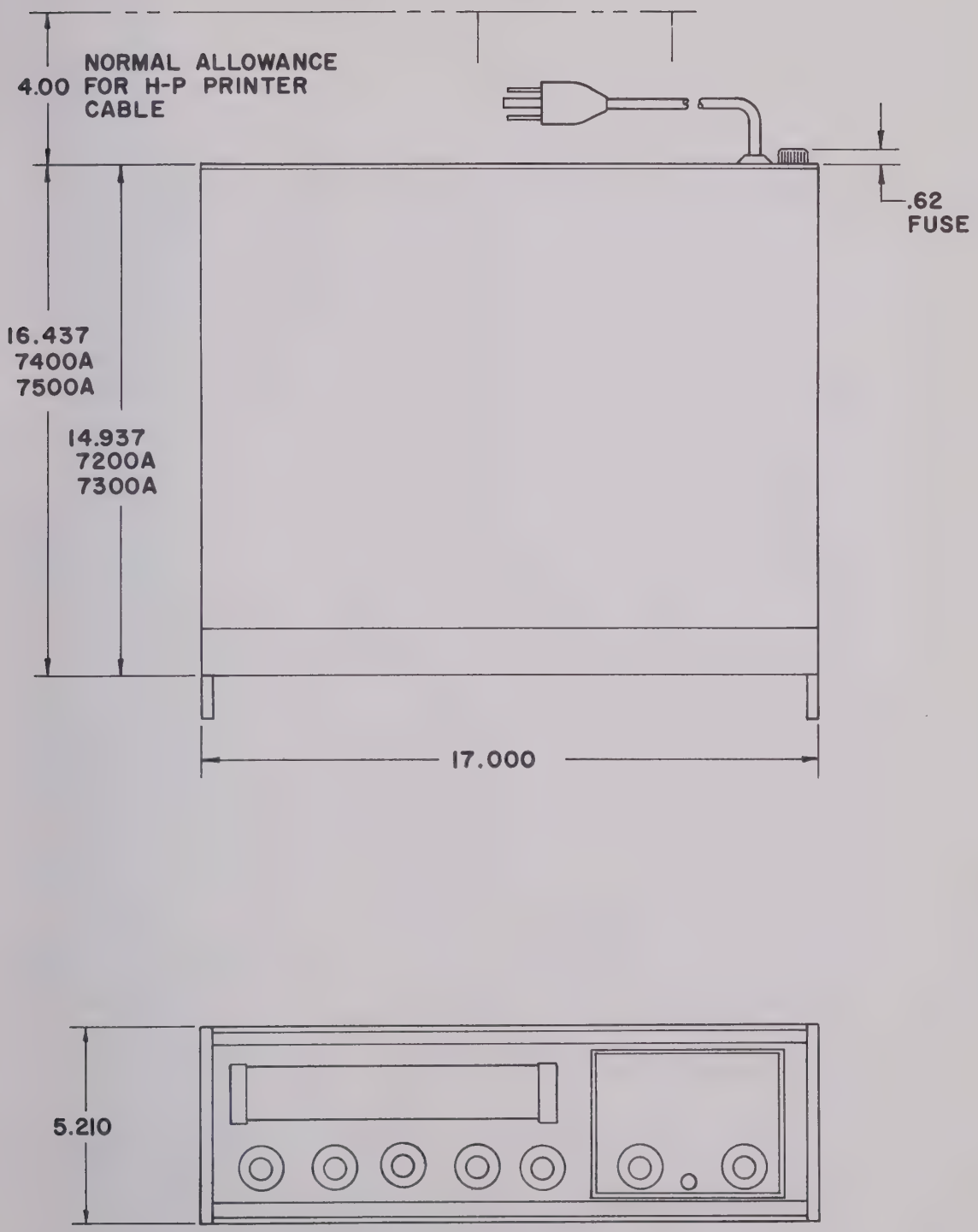


Figure 2-1. Dimensions, Front And Top, Series 7000A.

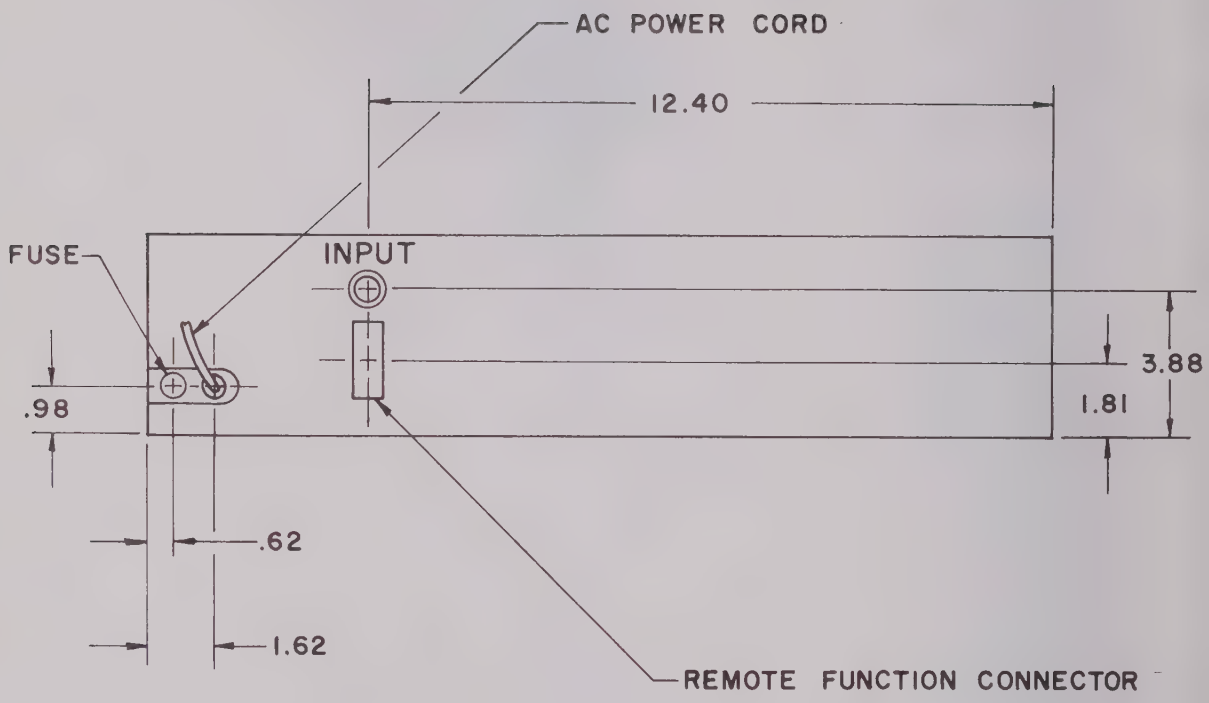
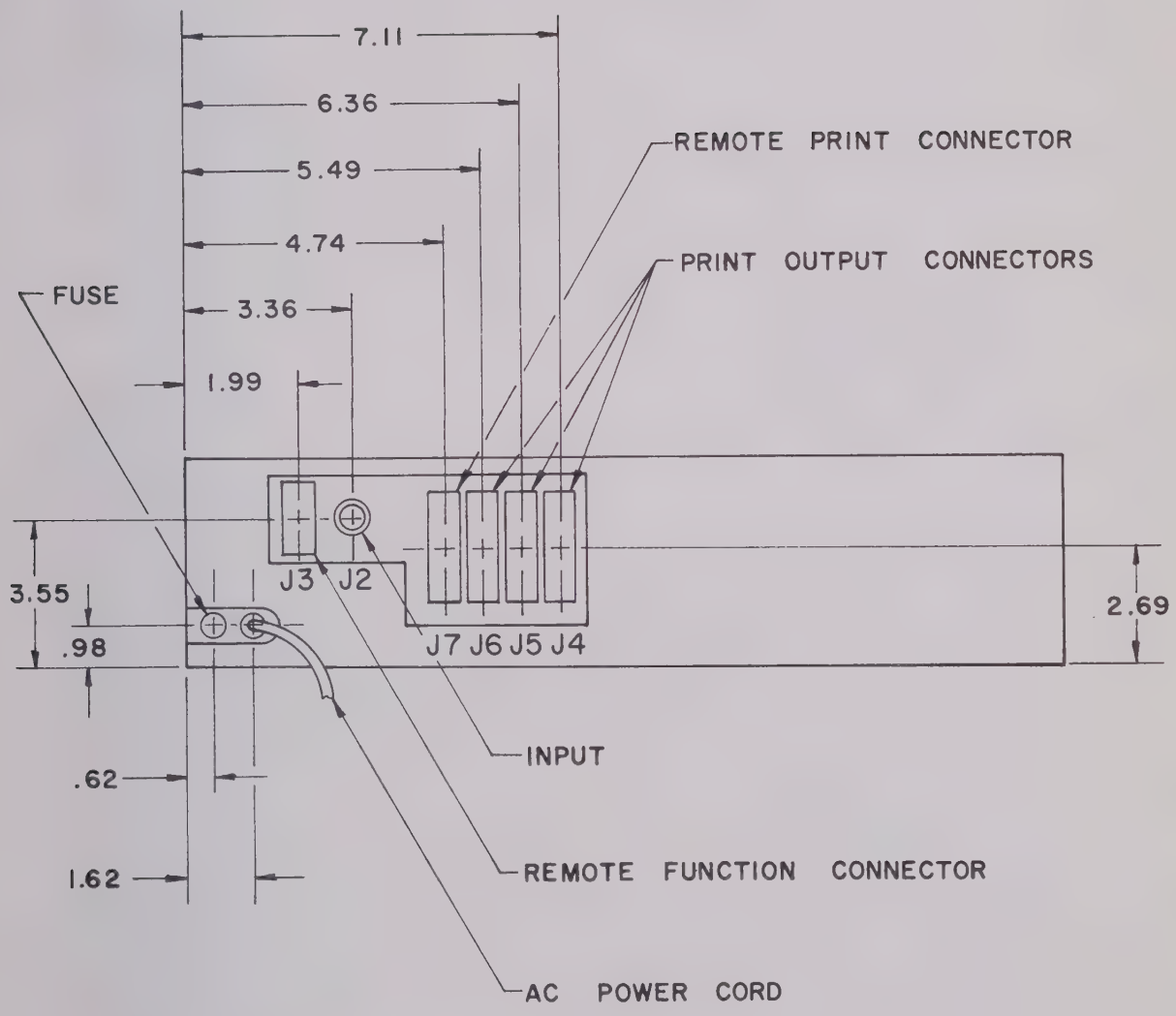
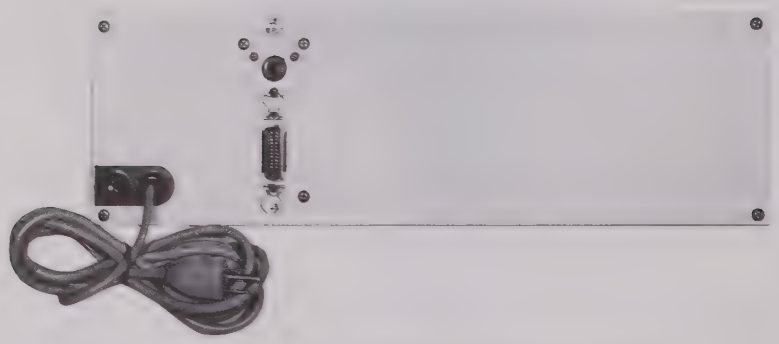


Figure 2-2. Dimensions, Rear Panel, Models 7200A and 7300A.

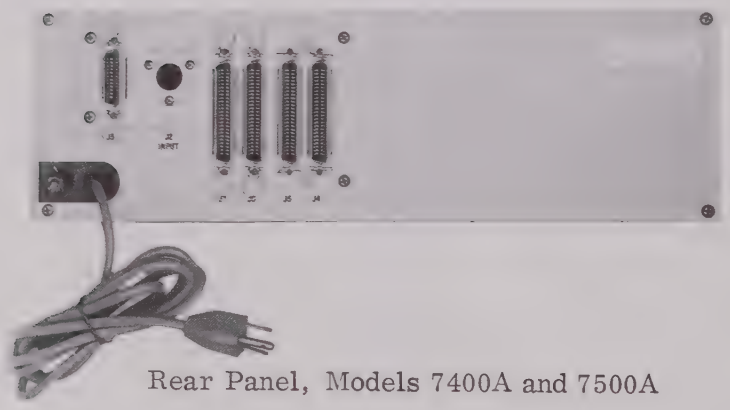


J4, J5, J6 & J7 ARE AMPHENOL NO. 57-40500
J3 IS AMPHENOL NO. 57-40240

Figure 2-3. Dimensions, Rear Panel, Models 7400A and 7500A



Rear Panel, Models 7200A and 7300A



Rear Panel, Models 7400A and 7500A

Figure 2-4. Rear Panel Model 7200A and 7200A, Rear Panel Model 7400A and 7500A.

SECTION III

PRELIMINARY INSPECTION AND OPERATION

TABLE OF CONTENTS

Paragraph	Page
INSPECTION AND OPERATION UPON RECEIPT	3-1
OPERATING CONTROLS	3-2

INSPECTION AND OPERATION UPON RECEIPT

The digital voltmeter is aligned, calibrated, and tested under severe environmental conditions prior to shipment. The instrument is therefore ready for immediate use upon receipt. The following checks should be made, however, to assure that the instrument has suffered no damage in shipment.

1. A visual inspection of the shipping container should be accomplished prior to acceptance from the carrier. If extensive damage of the shipping container is evident, a description of the damage should be noted on the carrier's receipt and signed by the carrier's agent. If damage is not apparent until the instrument is unpacked, a claim for concealed damage should be placed with the carrier within 15 days of receipt. All shipping containers and filler material must be kept for inspection.
2. A visual inspection for damage should be accomplished upon removing the instrument from the shipping container. Remove the top cover and guard shield and check for loose or broken components. Check to see that the printed circuit boards are mated with their connectors and are well seated. Remove the fuse from its packing container and install the fuse in the fuse holder on the rear panel.
3. Turn the POWER switch to OFF, the FUNCTION switch to DC, the SENSITIVITY control to HI and the DC RANGE switch to AUTO.
4. Insert the signal input plug into the signal input connector. Short all input clips together, see figure 3-1.

WARNING

Signal input connectors are available on the front and on the rear panels and are wired in parallel. The unused connector should be covered by the black, plastic safety cap supplied with the instrument to protect operating personnel from electrical shock.

5. Insert the power cord into a three-wire, 115V AC, 60 cps, single-phase power source. Turn the POWER switch to the ON position.

6. If a plug-in module is used to extend the versatility of the basic unit, i.e., AC-DC Converter, position the AUX RANGE switch on the module to the by-pass condition.
7. Position the DC RANGE switch sequentially to 10, 100 and 1000 and observe that the decimal point shifts to the proper position.

CAUTION

The Green input lead is terminated to DVM Chassis and POWER LINE GROUND. Therefore extreme caution must be used if the Green lead is to be used for the purpose of grounding a signal source. Follow these rules:

1. Determine whether the source is grounded.
2. If the signal source is already grounded, the Green lead should not be used as it will create a ground loop.
3. If the signal source is not grounded and truly floating (has no reference to Power Line Ground), the Green lead may be connected to the signal source low (Black lead) terminal. Noise and shielding of the signal to be measured will determine proper usage.

If these rules are not followed, serious internal damage to the DVM can occur. Any voltage applied to the Green input lead will be a direct short-circuit to Power Line Ground.

8. Connect any suitable low voltage battery between the red and black clips of the input cable. Connect the green clip to the black clip. The instrument should indicate the voltage and polarity of the battery cell.
9. Reverse the polarity of the input voltage. The instrument should indicate the change.
10. Remove the clips from the battery and short the clips together. The instrument should return to zero.
11. Turn the POWER switch to OFF and remove the power cord from the AC receptacle.

NOTE

The liability of CIMRON Corporation under the warranty is negated if the instrument is improperly repaired. If trouble is experienced during the above test, refer to the Appendix for warranty instructions before attempting repair.

OPERATING CONTROLS

All controls necessary for normal operation of the Series 7000A Digital Volt or Volt-Ratio Meters are located on the front panel. Front panel controls are shown on front panel photographs of each model on pages ii and iii. The function of each is outlined in table 3-1.

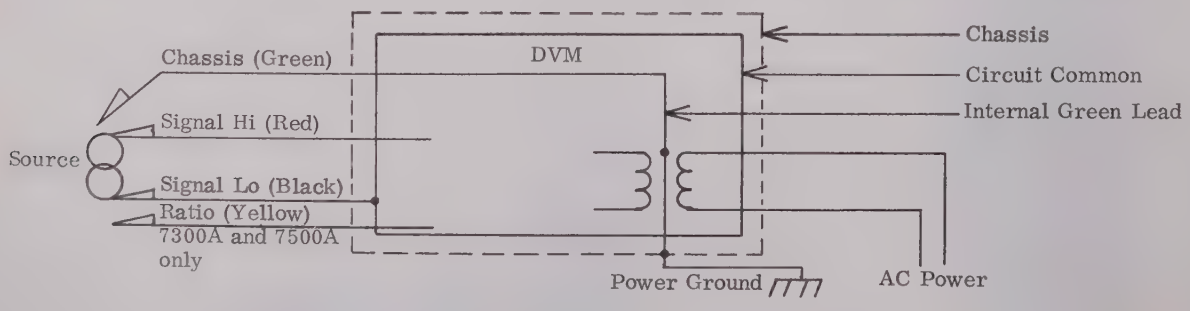


Figure 3-1. Voltmeter Input Leads and Grounding Connections.

Table 3-1. Front Panel Controls, Series 7000A Digital Volt or Volt-Ratio Meter.

CONTROL	POSITION	FUNCTION
POWER	OFF	AC power is removed from the instrument.
	STANDBY	AC power is applied although the logic circuits are held inoperative.
	FILTER-IN	AC power is applied. A filter is switched into the signal input circuit.
	FILTER-OUT	AC power is applied. The input filter is switched out.
	REMOTE	Input AC power is applied. The input filter is remotely controlled.
SENSITIVITY	VARIABLE 0 to 100uv (10V range)	The sensitivity control is a logarithmic taper potentiometer. At its extreme clockwise position, maximum sensitivity is obtained. The sensitivity is decreased as the potentiometer is turned counterclockwise. Prior to fully counterclockwise position, minimum or zero sensitivity is obtained and the instrument will not change reading.
PRINT CONTROL (Models 7400A and 7500A only)	AUTO-PRINT	The instrument will track the input signal and upon reaching a balance will automatically issue a print command signal through a rear connector.
	HOLD	Logic circuits are held inoperative, suspending voltmeter operation.
	TRACK	The instrument will track the input signal and upon null will not issue a print command.
	PRINT	The print position is a momentary contact closure which results in a print command signal at the time of closure. The command is issued without regard for the balance condition of the instrument.
FUNCTION	AC	The automatic ranging capability of the instrument is removed locking the instrument in the 9.9999 volt range. Control of the neon decimal indicator is transferred to the AC-DC Converter module when used.
	OHMS	The automatic ranging capability of the instrument is removed locking the instrument in the 9.9999 volt range. Control of the neon decimal indicator is transferred to the Ohms-DC Converter module when used.
	-RATIO-REF (Models 7300A and 7500A only)	The internal reference supply is disconnected. Provisions are made for an external reference supply to be connected across the reference potentiometer through the signal input connector. The polarity of both the external reference input and the signal input must be negative.

Table 3-1. Front Panel Controls, Series 7000A Digital Volt or Volt-Ratio Meter (Cont'd).

CONTROL	POSITION	FUNCTION
FUNCTION (Cont'd)	AUX	Automatic ranging capabilities are removed, locking the instrument in the 9.9999 volt range. Control of the neon decimal indicator is transferred to the preamplifier module when used.
	DC	The internal reference supply is connected to the potentiometer. Control of the neon decimal indicator is transferred to the DC RANGE switch. Polarity neon indicator is controlled by the input signal which may be bipolar. If a plug in other than the 6900A is in place, its AUX RANGE switch must be in BYPASS or DC position.
	+RATIO-REF (Models 7300A and 7500A only)	The internal reference supply is disconnected. Provisions are made for an external reference supply to be connected across the reference potentiometer through the signal input connector. The polarity of both the external reference input and the signal input must be positive.
	REMOTE	Any of the above modes of operation are remotely controlled.
DC RANGE	AUTO	The instrument accepts any voltage between 0.0000 and ±999.99 volts and automatically ranges to provide the proper input attenuation and correct decimal point position for maximum resolution.
	10	Low range scale, 100 uv sensitivity. Used when Auto Ranging is not desired.
	100	Medium range scale, 1 millivolt sensitivity. Used when Auto Ranging is not desired.
	1000	High range scale, 10 millivolt sensitivity. Used when Auto Ranging is not desired.

SECTION IV

CALIBRATION AND SPECIFICATION VALIDATION

TABLE OF CONTENTS

Paragraph	Page
CALIBRATION	4-1
REFERENCE STABILIZATION	4-1
ADJUSTMENTS	4-1
GATE DELAY ADJUSTMENT	4-2
SENSITIVITY ADJUSTMENT	4-2
UP BALANCE ADJUSTMENT	4-4
FAST UP ADJUSTMENT	4-4
REFERENCE SUPPLY CALIBRATION	4-4
ATTENUATOR ADJUSTMENT	4-5
RATIO OPERATION	4-5
PRINT DELAY ADJUSTMENT	4-6
SPECIFICATIONS VALIDATION	4-6
INPUT IMPEDANCE	4-6
AC COMMON MODE REJECTION	4-7
DC COMMON MODE REJECCTION	4-8
FLOATING VOLTAGE	4-8

CALIBRATION

The reference supply is calibrated against a stable voltage source of high accuracy. The attenuator is adjusted to provide an accurate 10:1 and 100:1 signal resolution ratio. To realize the full accuracy capabilities of the instrument, initial and periodic calibration of the reference supply and attenuator adjustment may be necessary. The following calibration procedure requires a stable DC power source with an output known to better than 0.01%.

REFERENCE STABILIZATION

Prior to calibration, the instrument must be placed in the environment of the calibration area for sufficient time to allow the internal temperature to stabilize. A stabilizing time of one hour for every 10°C change in temperature is required. Excessive temperature gradients resulting from a change in environment may cause thermal voltages to be generated which could affect the calibration.

After the instrument is turned on, a period of 90 minutes must be allowed for the reference supply to stabilize. The output voltage of the reference supply will approach 0.01% of its final value in a relatively short period of time. However, if the ultimate accuracy is to be realized, complete stabilization is necessary before calibration is attempted.

ADJUSTMENTS

The following adjustments are required before calibrating the reference supply and adjusting the attenuator. These are operational adjustments since they do not affect the accuracy of the instrument but are necessary for proper operation. However, the adjustment procedure including reference supply calibration and attenuator adjustment must be accomplished in the order given before commencing specification validation.

The following equipment is required to perform these adjustments:

1. Precision, stable, DC power supply.
2. Linear voltage divider.

3. Dual beam oscilloscope with a sensitivity of 200 microvolts per centimeter.

Remove the top and bottom covers and the larger inner guard shield. Connect the output of the power supply to the input of the voltage divider. The positive terminal of the power supply should be connected to the common terminal of the voltage divider and the negative terminal to the high terminal of the voltage divider. This will result in a negative voltage output. The output of the voltage divider is connected to the input of the instrument.

To review the necessary waveforms, connect the dual beam oscilloscope as follows:

1. Channel "A" input PreAmp Out
2. Channel "B" input Gate
3. Signal Common Signal Low
4. External Sync Sync

Position the oscilloscope controls as follows:

1. TRIGGER SELECTOR EXTERNAL AC
2. TIME/CM 50 usec/cm
3. SENSITIVITY "A" 1 mv/cm (X1 probe)
4. SENSITIVITY "B" 10 v/cm (X1 probe)

Position the instrument controls as follows:

1. FUNCTION DC
2. DC RANGE AUTO
3. PRINT CONTROL TRACK
4. SENSITIVITY HI
5. POWER ON-FILTER OUT

GATE DELAY ADJUSTMENT

1. Adjust the power supply to -10.000 volts.
2. Adjust the voltage divider to 00100.
3. Allow the instrument to arrive at balance; this condition is referred to as null.
4. Turn the SENSITIVITY control to LO.
5. Adjust the voltage divider to 00110.
6. Note the exact time position of the peak wave form at the PreAmp Out terminal. Figure 4-1 shows proper gate/error time relationship.
7. Adjust the DELAY control on the Logic Driver Assembly so that the leading edge of the gate pulse (channel "B") is 60 to 70 microseconds ahead of the peak PreAmp Out signal. See figure 4-2 for the location of this control.

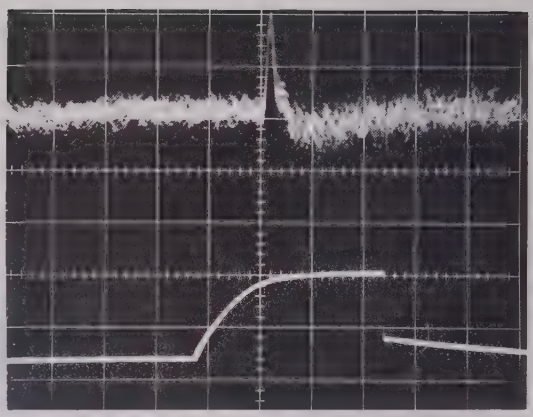


Figure 4-1. Gate/Error Signals.

SENSITIVITY ADJUSTMENT

1. Adjust the power supply to 1.0000 volts.
2. Adjust the voltage divider to 00100.
3. Position the SENSITIVITY control to HI.
4. Allow the instrument to arrive at null.
5. Slowly increase and then decrease the output of the voltage divider. Note that either a positive or a negative pulse can be made to appear at the PreAmp Out terminal.
6. Adjust the output of the voltage divider so that no pulse, neither positive nor negative appears. This is known as a true null.
7. Observe the reading on the instrument and the exact setting of the voltage divider.
8. Turn the SENSITIVITY control on the amplifier assembly 5 or 6 turns counter-clockwise. See figure 4-2 for the location of this control.
9. Observe that neither the instrument nor the voltage divider has changed.
10. Decrease the setting of the voltage divider by 00009 less than the final setting of paragraphs 7 and 9. If the final setting was 01000, the new setting would be 00991.

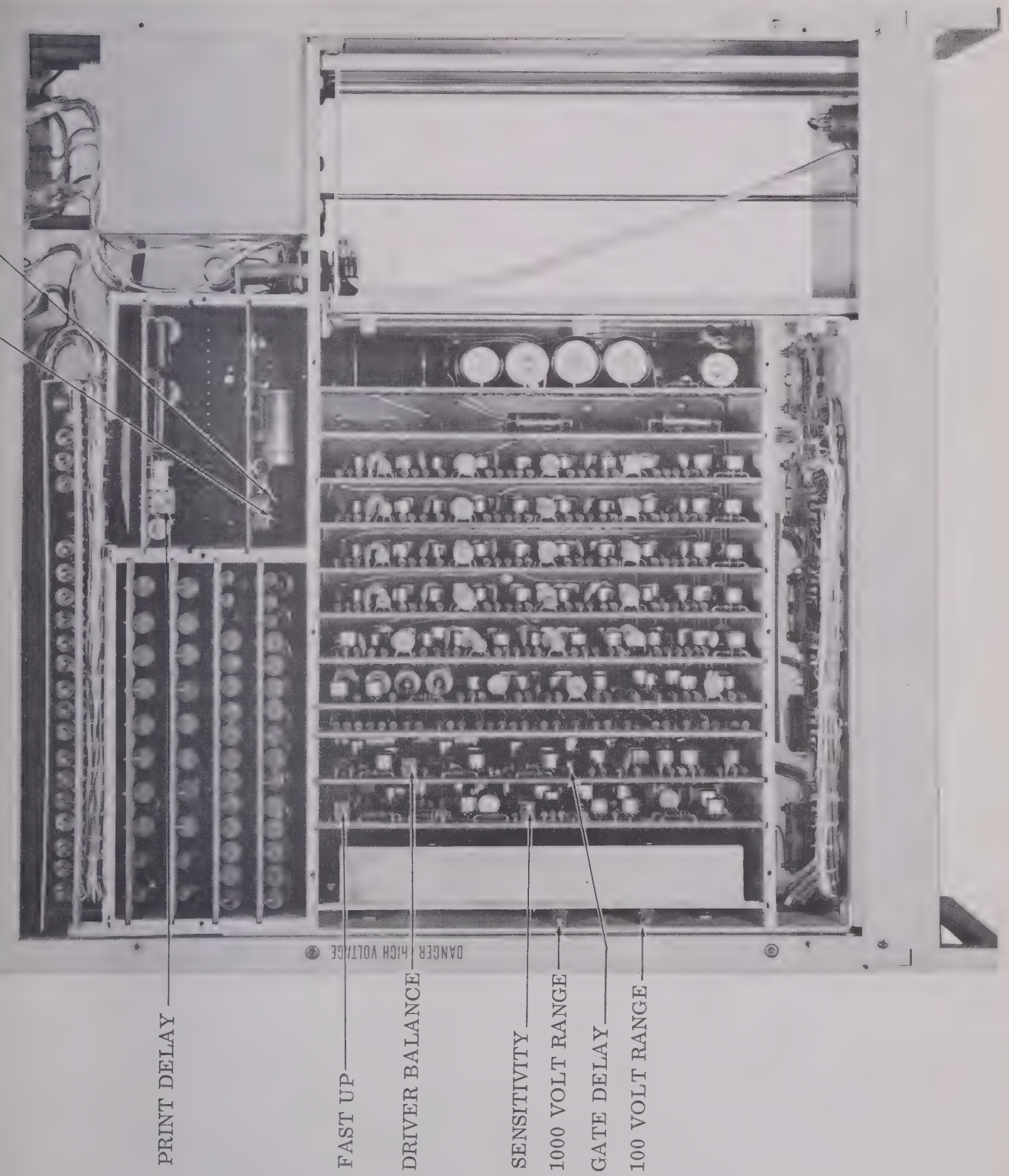


Figure 4-2. Internal Adjustments.

11. Slowly turn the SENSITIVITY control on the amplifier clockwise until the instrument display decreases by 0.0001 or one digit.
12. Adjust the voltage divider slightly to obtain a true null at the new setting.
13. Note the new setting and decrease it by 00009. The instrument should decrease by 0.0001 or one digit.

UP BALANCE ADJUSTMENT

1. Adjust the power supply to -1.0000 volts.
2. Adjust the voltage divider to 00100.
3. Position the SENSITIVITY control to HI.
4. Allow the instrument to arrive at null.
5. Adjust the output of the voltage divider to obtain a true null.
6. Observe the reading on the instrument and the exact setting of the voltage divider.
7. Turn the UP BAL control on the logic driver assembly 5 or 6 turns counterclockwise. See figure 4-2 for the location of this control.
8. Increase the output of the voltage divider from its setting at true null by 00009.
9. Slowly turn the UP BAL control clockwise until the instrument display increases by 0.0001 or one digit.
10. Adjust the voltage divider slightly to obtain a true null at the new setting.
11. Note the new setting and increase it by 00009. The instrument should increase by 0.0001 or one digit.

FAST UP ADJUSTMENT

1. Adjust the power supply to -1.0000 volts.
2. Adjust the voltage divider to 00100.
3. Allow the instrument to reach null.
4. Note exact setting of voltage divider.
5. Using clip leads, short circuit both the UP and the DOWN driver outputs to common.
6. Remove the oscilloscope probe from the gate terminal and connect it to the terminal marked FAST UP.
7. Turn the FAST UP control on the amplifier assembly 5 or 6 turns counterclockwise. See figure 4-2 for the location of this control.
8. Increase the voltage divider setting by 12000.
9. Slowly turn the FAST UP control clockwise until a negative pulse appears at the FAST UP terminal.
10. Remove oscilloscope.
11. Remove short circuits.
12. Continue with reference supply and attenuator calibration is so required.

REFERENCE SUPPLY CALIBRATION

To accurately calibrate the reference supply the following equipment is required:

1. Precision, stable DC power supply capable of supplying 10 volts known to better than 0.01%.
2. A linear voltage divider capable of resolving 10 microvolts output with 10 volts applied. Linearity shall be 0.005% or better.

Connect the output of the power supply to the input of the voltage divider. Connect the output of the voltage divider to the input of the instrument. Perform the following steps:

1. Position POWER switch to ON-FILTER OUT. Allow 90 minutes for the reference supply to stabilize.
2. Position the DC RANGE switch to AUTO.
3. Position the SENSITIVITY control to HI.
4. Position the FUNCTION switch to DC.
5. Position the PRINT CONTROL switch, where applicable, to TRACK.
6. Adjust the DC power supply for an output of 10.000 volts ±0.01%.
7. Adjust the voltage divider to 99950.
8. Note that 9.9950 is displayed on the instrument readout. If the reading differs from this value, sequentially adjust the COARSE and the FINE trim potentiometers (see figure 4-2) on the reference assembly to obtain this reading. After

adjusting, tap each control lightly to assure that the wiper arm is properly seated.

ATTENUATOR ADJUSTMENT T

The attenuator adjustment consists of setting the trim potentiometers in the input divider to provide an accurate 10:1 signal reduction on the 100 volt range and 100:1 signal reduction on the 1000 volt range.

The following equipment is required to accurately adjust the input divider:

1. A precision, stable DC power supply capable of supplying 100 and 1000 volts with an accuracy of ±0.01%.

Connect the output of the power supply to the input of the instrument. Perform the following steps.

1. Position the DC RANGE switch to AUTO.
2. Position the FUNCTION switch to DC.
3. Position the SENSITIVITY control to HI.
4. Position the POWER switch to ON and allow 90 minutes for reference supply to stabilize.
5. Position the PRINT CONTROL switch, where applicable, to TRACK.
6. Adjust the DC power supply to obtain an output of 99.900 volts ±0.01%.
7. Note that 99.900 is displayed on the instrument readout. If the reading differs from this amount by more than ±00.010 volts (0.01%), adjust the 100 volt range trim potentiometer (see figure 4-2) to obtain a reading within this tolerance.
8. Adjust the DC power supply to obtain an output of 999.00 volts ±0.01%. If an accurate power supply capable of 1000 volts is not available, a lower voltage supply may be substituted. However, it must be noted that the accuracy of the calibration will be proportionally less as the calibrating supply voltage is lowered.
9. Note that 999.00 is displayed on the instrument readout. If the reading differs from this amount by more than 0.01%, adjust the 1000 volt range trim potentiometer (see figure 4-2) to obtain a reading within this tolerance.

RATIO OPERATION (Models 7300A and 7500A only)

The instrument is designed to measure voltages by comparing an unknown voltage with a known voltage of the same polarity. The known voltage is referred to as the reference. Normally the voltage is supplied from an external source which may be any voltage from less than ±1.0 volt to ±100 volts. The instrument will display the quotient of the unknown voltage divided by the external reference.

When making RATIO measurements, the instrument will not auto-range. Normally these measurements are made with the unknown voltage less than the external reference voltage, and the RANGE switch should be in the AUTO or 10 position. When the unknown voltage to be ratio measured is greater than the external reference voltage and the RANGE switch is in the AUTO or 10 position, the instrument will indicate all nines, i.e., .99999. To determine the true ratio, it will be necessary to attenuate the unknown voltage with the RANGE switch until a value of readout is some figure less than .99999 by switching the RANGE switch to the 100 or if necessary to the 1000 position. The decimal point will always remain in the fifth or extreme left position when making ratio measurements, independent of RANGE setting. Therefore when ratio measurements are made with an unknown voltage that is obviously larger than the external reference voltage, the user must place the decimal point in the displayed quotient in the fourth position (x.xxxx) for a RANGE setting of 100 or in the third position (xx.xxx) for a RANGE setting of 1000.

The following equipment is required to demonstrate the instrument ratio capability.

1. Precision, stable 1 - 100 volt power supply.
2. Voltage divider with linearity to 0.005%.

Connect the equipment as shown in figure 4-3 and proceed as follows:

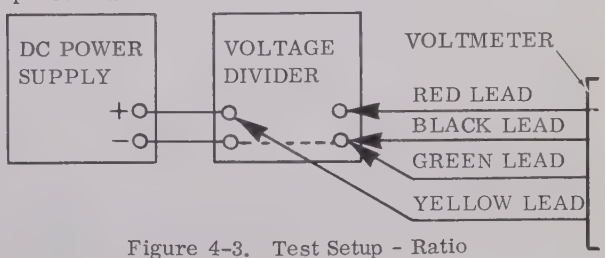


Figure 4-3. Test Setup - Ratio

1. Position the FUNCTION switch to RATIO +REF.
2. Position the DC RANGE switch to AUTO.
3. Position the PRINT CONTROL switch, on Model 7500A to TRACK.
4. Position the SENSITIVITY control to HI.

NOTE

It may be necessary to decrease sensitivity slightly to compensate for instabilities in the external reference power supply, particularly above 10 volts.

5. Position the POWER switch to ON-FILTER IN.
6. Adjust the power supply to obtain 10.0 volts output.
7. Adjust the voltage divider to 99990.
8. Note the reading displayed on the instrument. The reading should not differ from the setting on the voltage divider by more than ±.00007.
9. Adjust the power supply to +100 volts.
10. Note the reading displayed on the instrument. The reading should not differ from the setting on the voltage divider by more than ±.00007.
11. Adjust the power supply to 10.0 volts.
12. Adjust the voltage divider to 55550.
13. Observe the reading displayed on the instrument. The reading should not differ from the setting of the voltage divider by more than ±.00005.
14. Adjust the power supply to 100 volts.
15. Observe the reading displayed on the instrument. The reading should not differ from the setting of the voltage divider by more than ±.00005.
16. Adjust the power supply to 10.0 volts.
17. Adjust the voltage divider to 11110.
18. Observe the reading displayed on the instrument. The reading should not differ from the setting of the voltage divider by more than ±.00005.
19. Adjust the power supply to 100 volts.
20. Observe the reading displayed on the instrument. The reading should not differ from the setting of the voltage divider by more than ±.00005.
21. Reverse the connections to the power supply.
22. Position the FUNCTION switch to RATIO -REF.
23. Repeat paragraphs 6 through 22 to test operation on negative reference.

PRINT DELAY ADJUSTMENT (Models 7400A and 7500A only)

When the instrument reaches a balance and after a predetermined delay, a print command is issued. The amount of delay depends upon signal conditions and is adjustable. The delay may be decreased by counterclockwise rotation of the PRINT DELAY control.

SPECIFICATIONS VALIDATION

INPUT IMPEDANCE

In validating the instrument specifications it is necessary to measure input impedance. This is accomplished by measuring the input current at balance.

The following equipment is required to perform the input impedance test:

1. Resistor 1 meg, capacitor 1 mf.
2. Precision, stable DC power supply capable of supplying 10 volts ±0.01%.
3. A linear voltage divider.

Arrange the test equipment as shown in figure 4-4 and perform the following steps:

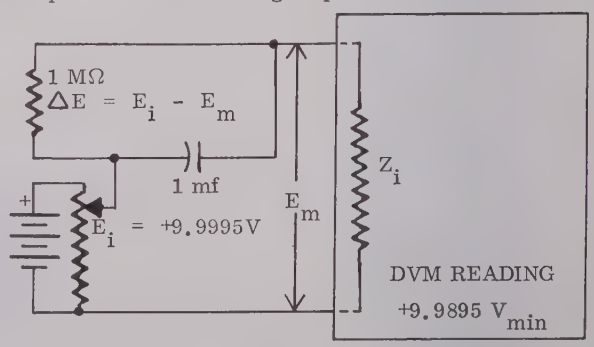


Figure 4-4. Test Setup - Input Impedance.

NOTE

Input shielding may be necessary in a noisy environment. High source impedance necessitates a 1mf shunt capacitor to stabilize DVM readout.

1. Position the POWER switch to ON-FILTER OUT.
2. Position the FUNCTION switch to DC.
3. Position the SENSITIVITY control to HI.
4. Position the DC RANGE switch to AUTO.
5. Position the PRINT CONTROL switch, where applicable, to TRACK.
6. Adjust the power supply to obtain 10.000 volts.
7. Adjust the voltage divider to 99995.
8. Note the reading displayed on the DVM. A drop of 0.0100 volts across 1 megohm represents a 1000 megohm input resistance at DC. The following computations illustrate the validity of this statement.

$$\text{INPUT CURRENT} = \frac{\Delta E}{10^6}$$

$$Z_i = \frac{E_m}{\text{INPUT CURRENT}}$$

$$\therefore Z_i = \frac{E_m}{\frac{\Delta E}{10^6}} = \frac{E_m}{\Delta E} \cdot 10^6 \Omega$$

AC COMMON MODE REJECTION

The effect of common mode signals on the operation of the instrument is a further parameter which is tested during the validation of the instrument specification. This is accomplished by applying a DC voltage of less than 2.000 volts between the signal HI and signal common inputs to the instrument. A common mode signal (60 cps AC) is then inserted between signal common and chassis ground. The common mode signal is slowly increased until instability is noted in the least significant decade of the instrument. At this point the error voltage resulting from the common mode signal is approximately 100 microvolts. The common mode rejection capability is then established by determining the ratio of the common mode signal to the resulting error voltage (100 microvolts) and expressing the solution in decibels.

$$\text{Common Mode Ratio} = \frac{\text{Amplitude Common Mode Sig}}{\text{Amplitude Resulting Error Sig}}$$

The following equipment is required to perform the AC common mode rejection test:

1. Wideband audio oscillator.
2. Battery of approximately 1.5 volts.
3. A voltmeter capable of measuring the rms amplitude of the common mode signal which will be in the order of 10 volts.
4. Resistors, 1K and 100 ohms, 1/2 watt.

Measure the resistance between signal common and chassis. The ohmeter should indicate a resistance of greater than 1000 megohms. Construct the test setup shown in figure 4-5 and perform the following steps:

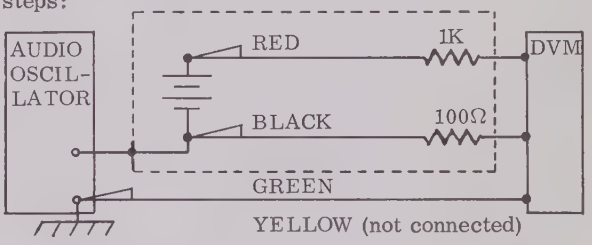


Figure 4-5. Test Setup - AC Common Mode.

1. Position the FUNCTION switch to DC.
2. Position the DC RANGE switch to AUTO.
3. Position the SENSITIVITY vontrol to HI.
4. Position the PRINT CONTROL, where applicable, to TRACK.
5. Position the POWER switch to ON-FILTER IN.
6. Note the reading displayed on the instrument.
7. Slowly increase the output of the AC audio oscillator until an instability occurs in the lease significant decade on the instrument.
8. A common mode signal in excess of 10 volts in amplitude will assure a common mode rejection of 100 db as shown in the computations below.

E_m = amplitude of common mode signal.
E_d = amplitude of error signal resulting.
CMR = common mode rejection ratio.

$$\text{CMR} = 20 \log \frac{E_m}{E_d} = 20 \log \frac{10}{10^{-4}} = 20 \log 10^5$$

CMR = 100 db.

DC COMMON MODE REJECCTION

The DC rejection characteristics of the instrument indicate its ability to measure low amplitude voltages accurately when the desired signal is floating on a large DC potential. The amount of DC which can be rejected is chosen as that voltage which when impressed between signal low and chassis ground will cause a change in the least significant decade of the instrument. The equipment required to perform this test is as follows:

1. 100 volt DC power supply.
2. DC voltmeter.
3. Battery of approximately 1.5 volts.
4. Resistors, 1K and 100 ohms, 1/2 watt.

Construct the test setup shown in figure 4-6 and perform the following steps:

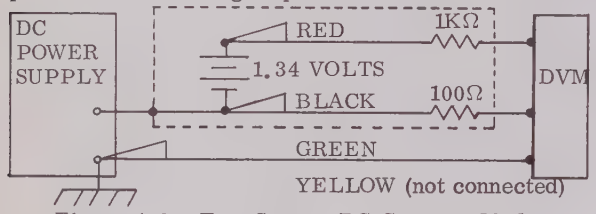


Figure 4-6. Test Setup - DC Common Mode.

1. Position the FUNCTION switch to DC.
2. Position the DC RANGE switch to AUTO.
3. Position the PRINT CONTROL, where applicable, to TRACK.
4. Position the SENSITIVITY control to HI.
5. Position the POWER switch to ON-FILTER IN.
6. Note reading displayed on instrument.
7. Increase the power supply voltage until an instability is noted. Do not exceed ±500 volts.

For purpose of validation it is only necessary to apply ±100 volts to demonstrate 120 db of DC common mode rejection. This is substantiated as follows:

E_{cm} = amplitude of common mode voltage.

E_d = amplitude of resulting error voltage.

CMR = common mode rejection ratio

$$CMR = 20 \log \frac{E_{cm}}{E_d} = 20 \log \frac{100}{10^{-4}} = 20 \log 10^6$$

CMR = 120 db.

FLOATING VOLTAGE

The instrument will measure voltages floating up to ±500 volts DC or 500 volts peak AC. This procedure will determine the ability of the instrument to float the input signal. The following equipment is required to perform the floating voltage test:

1. Vacuum tube voltmeter.
2. 500 volt DC power supply.

Using the VTVM measure the resistance between signal common and chassis ground. The VTVM should indicate a resistance of >1000 megohms.

Construct the test setup indicated in figure 4-6 and proceed as follows:

1. Position the FUNCTION switch to DC.
2. Position the DC RANGE switch to AUTO.
3. Position the PRINT CONTROL, where applicable, to TRACK.
4. Position the SENSITIVITY control to HI.
5. Position the POWER switch to ON-FILTER IN.
6. Observe reading displayed on instrument.
7. Adjust the power supply to ±500 volts.
8. Observe the instrument still operates properly.

NOTE

When the voltage is suddenly applied, the instrument will temporarily exhibit a transient effect.

SECTION V

THEORY OF OPERATION

TABLE OF CONTENTS

Paragraph	Page
GENERAL	5-1
CIRCUIT DESCRIPTION	5-2
POTENTIOMETER	5-2
ATTENUATOR AND PRE-AMP	5-2
AMPLIFIER	5-4
LOGIC DRIVER	5-5
LOGIC MATRIX	5-6
UNITS, 10, 100 AND 1K DECADES	5-6
10K DECADE	5-7
RANGE AND POLARITY	5-7
POWER SUPPLY	5-9
REFERENCE	5-9
PRINT CONTROL	5-10
DOWN RANGE CONTROL	5-10
DETAIL LOGIC	5-10
UP DRIVE ONLY	5-10
FAST-UP DRIVE WITH UP DRIVE	5-11
DOWN DRIVE ONLY	5-11

GENERAL

The Series 7000A Digital Volt and Volt Ratio Meter is essentially a closed loop servo system. The principle of operation is one of voltage comparison. An unknown voltage is determined by comparing it with a known reference voltage across which is connected a potentiometer. A sensing device is connected between the unknown voltage and the potentiometer arm (figure 5-1). The value of the unknown voltage is determined by moving the potentiometer arm until the sensing device indicates that the potentiometer voltage and the unknown voltage are equal. This is known as a "null" condition. In this case, the potentiometer is an accurately calibrated series of resistors which are traversed in fixed increments and the unknown voltage may be computed by factoring the reference voltage by the potentiometer setting. The physical movement of the potentiometer arm is directly tied to an indicator system which indicates the value of the unknown voltage when a null condition is achieved.

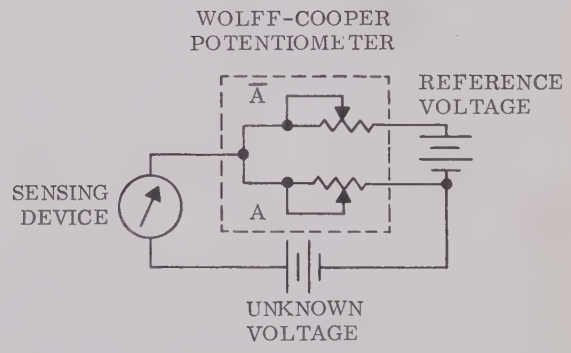


Figure 5-1. Potentiometer Nulling Arrangement.

Potentiometer positioning and readout of the unknown voltage is accomplished by the servo system (figure 5-2) activated by the difference sensed in a voltage comparison circuit.

Voltage comparison (figure 5-3) is accomplished by an electromechanical chopper which samples the unknown voltage and the reference voltage alternately approximately 180 times per second. These two

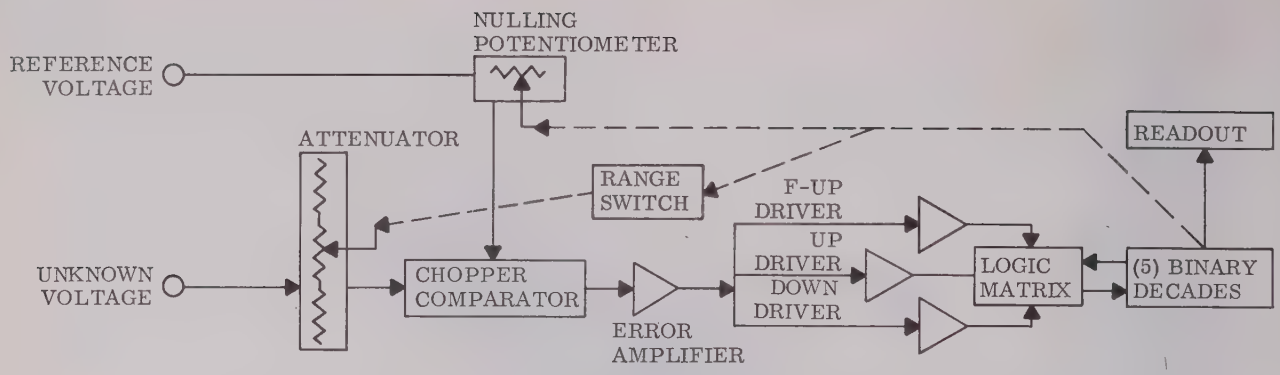


Figure 5-2. Simplified Block Diagram of Voltmeter Closed Loop Servo System.

voltages are compared by the chopper which produces an output pulse that is proportional in phase and amplitude to the difference between the two values. The difference or error voltage sensed by the chopper is applied to a transistor error amplifier where it is amplified and properly polarized with respect to the reference voltage. A second amplifier further amplifies and directs the error signals to three logic circuit inputs: i.e., UP, DOWN or FAST UP drivers. The outputs of the three drivers are directed by the logic matrix, which continually senses the potentiometer arm position, to the appropriate binary decade assemblies which cause the potentiometer to null. Neon indicator tubes in the readout, monitor the position of the potentiometer arm and indicate the decimal equivalent of the analog of the input voltage.

CIRCUIT DESCRIPTION

POTENTIOMETER (See drawings 70-0712 and 70-0713, pages 6-43 and 6-47)

There are four boards in this assembly, arranged as two complimentary rheostats connected in a Wolff-Cooper bridge configuration (figure 5-4). As the nulling section of the potentiometer is switched from 0 to 100,000 ohms, the balancing section is varied inversely. This maintains a constant impedance to the reference source and diminishes the possibility of reference instability due to load variation. Nulling of the unknown and reference voltages is accomplished by switching potentiometer component resistors in or out of the series circuit in accordance with commands from the binary decade assemblies.

Each decade assembly commands a four resistor balancing and a four resistor nulling section of the potentiometer. The commands issued by the decades are in the form of 4-2-2-1 BCD which activate reed switches to adjust the value of the potentiometer. The block diagram, figure 5-3, shows the potentiometer switched to correspond to an indicated decimal reading of 40295.

The "0" state of the counting binaries in the decade assemblies is its low voltage output condition, i.e., transistor biased on. The "1" state output is approximately ±17 volts. When a binary is in the "0" state, an associated reed switch is turned on, shorting out a corresponding section of the potentiometer. The nulling section of the potentiometer is controlled by the $\overline{A}$, $\overline{B}$, $\overline{C}$ and $\overline{D}$ (not A, not B, not C and not D) outputs of the decades while the balancing section is controlled by the A, B, C and D sections. Whenever an A, B, C or D output of a binary is in the "0" condition, its $\overline{A}$, $\overline{B}$, $\overline{C}$ and $\overline{D}$ counterparts are in the "1" condition. Figure 5-3 illustrates that a decimal reading of 5 requires that binary outputs $\overline{A}$, $\overline{B}$, C and $\overline{D}$ close their relays and A, B, $\overline{C}$ and D open. At a reading of 00000, the $\overline{A}$, $\overline{B}$, $\overline{C}$ and $\overline{D}$ reeds are all open ("1" output condition) and for a reading of 99999 these reeds are all closed ("0" output condition).

ATTENUATOR AND PRE-AMP (See drawing 70-0706, page 6-15)

The voltage to be measured is applied to a relay controlled attenuator switch which may be controlled manually or automatically to accommodate the amplitude of the signal. Since the reference voltage is 10

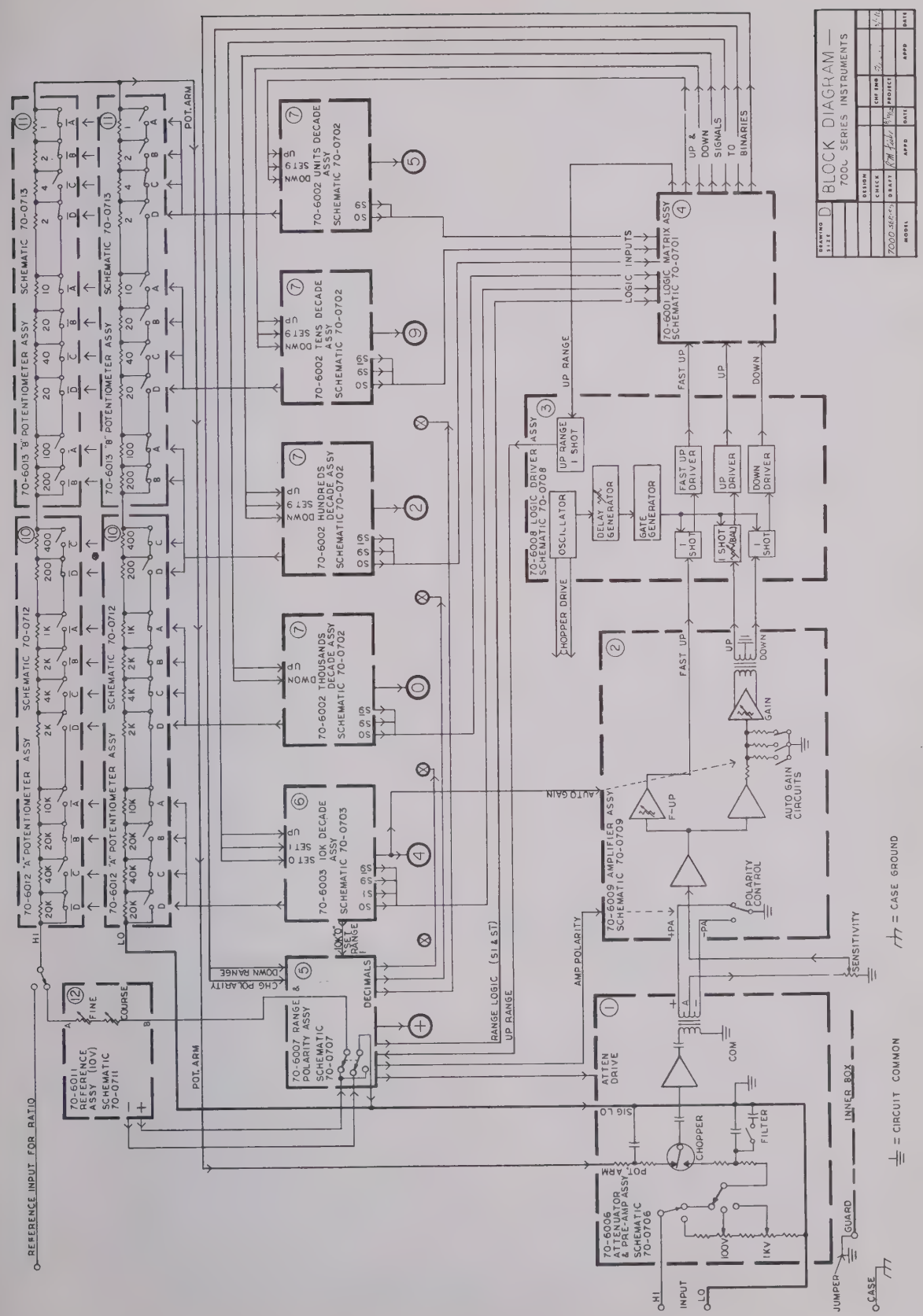


Figure 5-3. Block Diagram, Series 7000A.

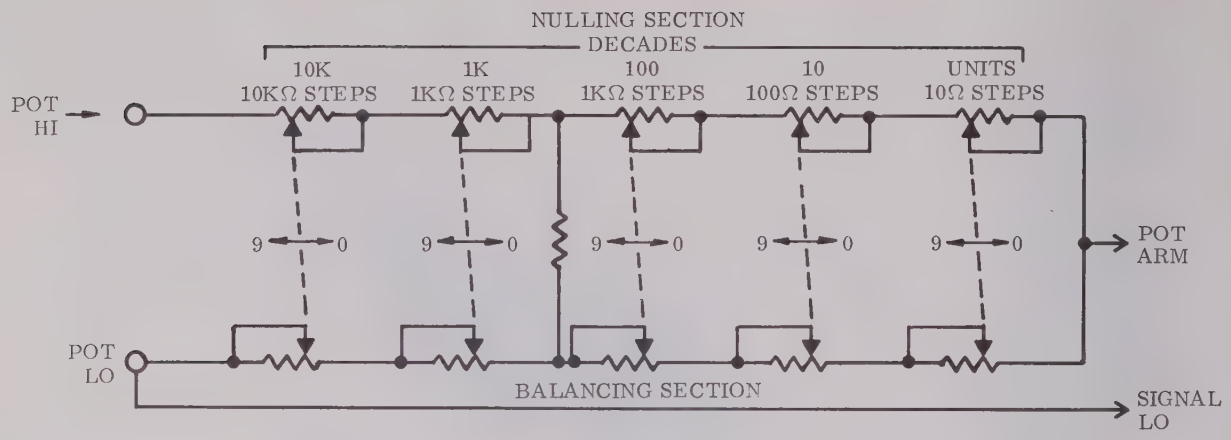


Figure 5-4. Wolff-Cooper Potentiometer.

volts, the range of the voltmeter is basically 9.9999 volts. Larger input or signal voltages are attenuated 10 or 100 times to provide measuring ranges of 100 or 1000 volts respectively. A fixed filter is incorporated in the output of the attenuator to remove high frequency noise. When required, additional filtering is available which may be added manually or remotely. With the additional filter added, the reading time of the instrument is increased, since it is a function of the response time of the filter. The output of the logic controlled potentiometer (reference voltage) is also connected to this assembly. An electromechanical chopper compares the input signal and the reference voltage approximately 180 times per second. The chopper output is a square pulse proportional to the amplitude and polarity difference of the compared voltages. The pulse is differentiated and applied to the input of a low noise amplifier which provides approximately 30 db gain and signal polarization. The amplifier output is transformer coupled. The secondary winding of the transformer is center tapped and wired to a front panel mounted SENSITIVITY potentiometer which provides excitation for the next assembly.

AMPLIFIER (See drawing 70-0709, page 6-19)

The output of the SENSITIVITY control provides the signal input for this assembly. Start and finish of the secondary winding of the pre-amp output transformer are connected to two transistor switches Q901 and Q902, which on command from the range and polarity assembly ground one end or the other to maintain proper polarity relationship with the reference voltage. This circuit is necessary to accommodate polarity reversal of the input signal.

The signal input drives an emitter follower stage, Q905 which furnishes input for two amplifiers, one of which, Q904, is designated FAST-UP. When an error signal of greater than approximately 1.2% of full scale exists in the "up" direction, i.e., toward an increasing reading, the FAST-UP amplifier drives a separate driver system whose sole function is to provide a shortcut in the logic for large up errors.

The other amplifier Q906, driven by the emitter follower provides approximately 20 db gain and a low output impedance, to drive the auto gain attenuator. The three attenuator sections are selected by transistor switches which are controlled by the 2 through 9 decimal output of the 10K (most significant digit) decade board. The auto gain circuit improves stability of the instrument by reducing system sensitivity as the readout approaches full scale.

The auto gain circuit consists of resistors R929, R930, R932 and R934 and the auto gain attenuator switches Q908, Q909 and Q910. The transistors are normally biased to cutoff by +25 volts through resistors R916, R917 and R918.

All three auto gain switches operate in the same manner, providing various amounts of attenuation depending on the decimal count of the 10K decade.

When, for example, the 10K decade registers a count of 3, decimal output circuit 3 approaches ground potential and removes the reverse bias to Q908 through the diode CR902. This reverse bias is normally supplied through resistor divider R916, R925 and R928. As Q903 saturates, it connects R930 to circuit common. The attenuator output from the junction of R929 and R930 is applied to the input of Q911.

Amplifier stage (Q911) has a gain adjustment in the emitter circuit. The output is coupled to an inverting amplifier, which in turn is transformer coupled to a pair of emitter followers, Q915 and Q916. Q915 provides output for the UP driver and Q916 provides output for the DOWN driver.

LOGIC DRIVER (See drawing 70-0708, page 6-23)

The logic driver assembly provides the following signals: UP RANGE drive, UP drive, DOWN drive, FAST UP drive, gating pulses and the chopper drive.

The oscillator consisting of Q801 and Q802 is an astable multivibrator which provides an output pulse of approximately one millisecond at a repetition rate of approximately 180 times per second. The pulse width and frequency are determined by C801, R803, C802 and R805. Two switching transistors, Q808 and Q809, provide buffering between the chopper and the oscillator.

The multivibrator output is also fed to the delay generator, transistors Q803 and Q804 connected as a monostable multivibrator. The trailing edge of the pulse from Q803 triggers another monostable multivibrator consisting of Q806 and Q807 which generates a gating pulse for the UP, DOWN anf FAST UP drivers. When the delay generator is triggered by the oscillator it remains in the unstable state until capacitor C805 discharges. The discharge rate is controlled by DELAY potentiometer R807. The gate generator is fired by the trailing edge of the delay pulse. Its timing is adjusted by the DELAY potentiometer to place it in proper time relationship with the chopper-detected error signals.

The UP, DOWN and FAST UP drivers consist of one-shot multivibrators, each driving one output amplifier (Q819, Q823 and Q815 respectively). Since all drivers are identical, only one is discussed in detail. The one-shot section of the UP driver, consisting of Q816 and Q818, is held inoperative by gating transistor Q817. When the gate generator pulse drives the base of Q817 positive, Q816 is triggered by a positive signal at its base. This input signal is the UP output of the preceeding amplifier. When Q816 fires, Q818 cuts off and couples a signal to Q819, the UP output driver which is normally cut off. This causes a negative pulse output of approximately 25 volts at the collector of Q819. This pulse is fed to the logic matrix for direction to the proper decade.

The three drivers are positively interlocked in such a manner that if the DOWN driver fires, the UP and FAST UP drivers are disabled. When the UP driver fires, the DOWN driver is disabled. The FAST UP driver does not provide an interlock because the UP driver always fires when the FAST UP driver fires. The DOWN driver fires independently.

When a down pulse is applied to the input of the DOWN driver through C816, its output amplifier Q815 becomes saturated. The negative potential from the collector of Q815 is applied to the base of the UP and FAST UP driver gating transistors Q817 and Q821. Thus the UP driver and FAST UP driver cannot fire during the duty cycle of the DOWN driver. When an up pulse is applied to the UP driver through C821, its output amplifier, Q819, becomes saturated, the negative potential from the collector of Q819 is applied to the base of the DOWN driver transistor gate, Q813. Thus, the DOWN driver cannot fire during the duty cycle of the UP driver. When the FAST UP driver is firing the UP driver is also firing, which interlocks the DOWN driver.

The trigger level of the one-shot in the UP driver is controlled by BALANCE potentiometer R854, used to equalize the level at which the UP and DOWN drivers fire.

The UP-RANGE driver is a monostable multivibrator connected between the logic matrix and the range and polarity assembly. The monostable delays

consecutive UP-RANGING signals long enough to allow the input filter to reach equilibrium and prevent erroneous DOWN RANGING. The time constant of this one-shot is controlled by relay K11 (open for FILTER IN) to accommodate input filter characteristics.

LOGIC MATRIX (See drawing 70-0701, page 6-27)

The logic matrix consists of three networks of resistors and diodes which direct signal pulses from the logic driver assembly to the correct inputs of the five decades or the range and polarity circuits. Each of the decades and the range and polarity assembly have logic outputs which enable the logic matrix to determine which unit should receive a particular drive pulse. The logic signals to the matrix are termed shift signals, identified by the letter "S" followed by a numeral. The logic signals have two possible states, "go" or "no go". In some cases, complimentary logic signals are required. These are identified by $\overline{S}$ or NOT SHIFT. All logic signals are connected to the logic matrix together with the FAST UP, UP, and DOWN signals from the logic driver. Shift signals in the "no go" condition provide diode clamps on unwanted matrix output signals. The logic automatically directs pulses to the proper counting circuits. Refer to paragraph entitled LOGIC DETAIL for further explanation of counting sequences.

UNITS, 10, 100 AND 1K DECADES(See drawing 70-0702, page 6-31)

Each of these four identical and interchangeable assemblies consists of a four binary 4-2-2-1 BCD counter, a BCD decimal decoder, decimal readout drivers, and the required logic shift circuits. The 10, 100, and 1K decades provide S0, S9 and $\overline{S9}$ shift outputs for the logic matrix while the units decade provides only S0 and S9. Each decade except the 1K decade accepts UP, DOWN and SET9 inputs. The 1K decade accepts only UP and DOWN inputs.

Each of the four counting binary circuits on a decade assembly has two complimentary BCD outputs. These 4-2-2-1 BCD outputs operate the reed relays to establish the value of the nulling potentiometer, in the manner discussed in the paragraph headed POTENTIOMETER.

The BCD to decimal decoder translates, through a diode matrix, the 4-2-2-1 BCD information contained in the decade assembly into ten digit 0-9 decimal information which is used to drive the horizontal neon indicators through transistor drivers Q213 through Q222.

Assume the decade assembly is registering a 0 count. Q207, Q205, Q203 and Q201 are turned on, i.e., conducting and their collectors are near zero volts. Q208, Q206, Q204 and Q202 are turned off; their collectors are at approximately +17 volts. Decimal decoder diodes CR223, CR230, CR241 and CR253 are back biased. The base of transistor Q213 is biased in a forward direction from +23 volts through R248. Q213 is saturated and the 0 neon indicator is on. The binary outputs $\overline{A}$, $\overline{B}$, $\overline{C}$ and $\overline{D}$ are all "no go". When an UP pulse is directed to the decade by the matrix, it is applied through R242 and C220 to steering diodes CR208 and CR209 of binary A. Since the UP pulse is negative in pularity it is directed to the base being held positive by the binary cross-over network, in this case Q207. Q207 is turned off. As the collector of Q207 becomes positive, it forward biases Q208 which becomes saturated. As Q208 saturates it removes forward bias from Q213 through diode CR253, turning off the 0 neon indicator. Q214 becomes saturated because of reverse bias across the decoder diodes CR224, CR231, CR242 and CR247 and the 1 neon indicator is turned on. The binary output is now $\overline{B}$, $\overline{C}$, $\overline{D}$ "no go" and $\overline{A}$ "go". On the next UP pulse, Q208 is turned off. Q207, in turning on, furnishes a negative pulse through C217 and diode CR201 to the base of Q201 in the D binary, and through R224 and C214 to the steering diodes in the B binary. Q201 is turned off and Q202 turned on in the D binary. A positive pulse, present at the collector of Q201, is returned through R201 and C213 to the steering diodes in B binary. The feedback prevents B binary from being affected by the negative pulse from binary A. The binary outputs are now $\overline{A}$, $\overline{B}$, $\overline{C}$ "no go" and $\overline{D}$ "go". The decimal decoder causes the numeral 2 neon indicator to light. The D binary will remain in its present condition until it is reset to 0 by a down pulse. The third up pulse thrns Q208 on and turns Q207 off. The

positive pulse at the collector of Q207 does not affect the B or D binaries because of the polarity of the steering diodes CR208, CR209 and CR201. The fourth UP input pulse turns Q207 on and Q208 off. The negative pulse at Q207 is coupled to binary B through R224 and C214. Q206 is turned on and Q205 is turned off bringing the binary count to $\overline{A}$, $\overline{C}$ "no go" and $\overline{B}$, $\overline{D}$ "go". The decimal decoder causes neon indicator numeral 4 to light. The fifth UP input pulse causes A binary to change state; turn Q207 off and Q208 on. Since the pulse generated at the collector of Q207 by this change state is positive, it does not affect the state of any of the other binaries. The sixth UP pulse again changes the state of the A binary, which presents a negative pulse to the B binary. The B binary changes state and sends a negative signal to the C binary steering diodes. C binary changes state. Q203 turns off and Q204 turns on. The binary output is now $\overline{D}$, $\overline{C}$ "go". The seventh UP pulse changes state of the A binary, turning Q207 off and Q208 on, but since the output of the A binary is positive none of the other binaries are affected. The eighth UP pulse changes the state of the A binary, causing Q206 in the B binary to conduct and Q205 to be turned off. Binary outputs are now $\overline{B}$, $\overline{C}$, $\overline{D}$ "go". The ninth UP pulse changes the state of A binary again while not affecting any others. The binary outputs are $\overline{A}$, $\overline{B}$, $\overline{C}$, $\overline{D}$ "go".

Each decade assembly contains two shift circuits. One consists of pnp transistor Q212 (S0). When the binaries are in the zero count with Q202, Q204, Q206 and Q208 turned off, diodes CR222, CR229, CR240 and CR256 are reverse biased, allowing Q212 to produce a "go" signal at S0 output. When the decades are registering any count other than 0, the 0 shift transistor is biased on and the S0 output is "no go".

The other shift circuit consists of a conventional binary Q210 and Q211, a gating transistor Q209 and a transistor switch Q223. When the counting binaries are registering any count other than 9, the shift binary is held inoperative by the gate transistor Q209 and the S9 output is "no go". Switching transistor Q223 is biased on to produce a "go" $\overline{S9}$ output. When the counting binaries reach a count of 9, the shift binary gate Q209 is turned on through decoding diodes CR210, CR207 and CR204. The shift binary clamps the UP pulses going to the A binary, preventing the decade from further counting. At this point it can only accept DOWN pulses. A DOWN pulse resets all binaries so the binary count is $\overline{A}$, $\overline{B}$, $\overline{C}$, $\overline{D}$ "no go" and decimal output is 0.

The chart in table 5-1 shows the counting sequence and the binary conditions for each decimal and BCD count.

10K DECADE (See drawing 70-0703, page 6-35)

With the exception of minor input and output variations this decade and its counting sequence is identical to the ones described in the preceeding paragraphs. There are three inputs: UP, SET 0 and SET 1. The UP is the normal counting input. The SET 0 input resets the decade to the 0 count from any other count and the SET 1 input resets the decade to a count of 1 from any other count. An additional output, S1, from transistor Q313, is applied to the matrix when the decade is registering a 1 count in the same manner as S0 in the other decades.

RANGE AND POLARITY (See drawing 70-0707, page 6-39)

The polarity section of this assembly consists of a conventional bistable multivibrator Q703 and Q704, actuating two of four transistor switches in either of its stable states. Q701 and Q702 reverse the polarity of the reference voltage supplied to the Wolff-Cooper potentiometer each time the binary changes state and Q705 and Q706 change polarity readout. The binary collectors are also connected to the amplifier assembly for polarity referencing of the error signal. When all decade units are sensed by the logic matrix to be in the 0 count condition and the range binaries are in the 1 (10 volt) range, the logic matrix will pass the next down pulse to the polarity binary. This causes the polarity binary to change state, reversing the polarity of reference, amplifier and readout. Each time a down signal is received by the polarity binary, it will change state and reverse the polarity of reference, amplifier and readout.

Table 5-1. Count Sequence and Binary Conditions.

BINARY OUTPUT	DECIMAL EQUIVALENT										BCD COUNT
	0	1	2	3	4	5	6	7	8	9	
A	-	+	-	+	-	+	-	+	-	+	1
$\overline{A}$	+	-	+	-	+	-	+	-	+	-	
B	-	-	-	-	+	+	-	-	+	+	2
$\overline{B}$	+	+	+	+	-	-	+	+	-	-	
C	-	-	-	-	-	-	+	+	+	+	4
$\overline{C}$	+	+	+	+	+	+	-	-	-	-	
D	-	-	+	+	+	+	+	+	+	+	2
$\overline{D}$	+	+	-	-	-	-	-	-	-	-	

\+ = Binary turned off, Collector at +17 V
\- = Binary turned on, Collector at 0 V

Counting Sequence

DECIMAL EQUIVALENT	TURNED ON	TURNED OFF
1	$\overline{A}$	$\overline{B}\overline{C}\overline{D}$
2	$\overline{D}$	$\overline{A}\overline{B}\overline{C}$
3	$\overline{A}\overline{D}$	$\overline{B}\overline{C}$
4	$\overline{B}\overline{D}$	$\overline{A}\overline{C}$
5	$\overline{A}\overline{B}\overline{D}$	$\overline{C}$
6	$\overline{C}\overline{D}$	$\overline{A}\overline{B}$
7	$\overline{A}\overline{C}\overline{D}$	$\overline{B}$
8	$\overline{B}\overline{C}\overline{D}$	$\overline{A}$
9	$\overline{A}\overline{B}\overline{C}\overline{D}$	

The range section of this assembly consists of two binary circuits: Q709, Q710 and Q711, Q712, tied together to produce three sequential decimal outputs by means of a BCD to decimal decoder consisting of CR716, CR717, CR718, CR719 and CR720 and three transistor switches Q714, Q715 and Q716. Another pair of transistor switches, Q707 and Q708, furnish logic inputs of S1 and $\overline{S1}$ to the matrix. The decimal outputs actuate attenuator switching relays and neon range indicators while the shift outputs provide condition identification to the matrix.

Two inputs, 10K 0 and SET R1, force the binaries into range 1 (10 volts) thereby keeping the instrument locked in the range 1 position when the 10K decade is registering 0 or the FUNCTION switch is in the AUX position. When either of these conditions exist the forward bias is removed from Q713 and it is cut off. With Q713 in the cutoff condition, both range binaries are held inoperative and forced to issue a range 1 command output.

The range binaries cause the attenuator and indicators to UP RANGE when all decades are registering a 9 count and additional UP pulses are present. The logic SHIFT 9 input unclamps the UP signal supplied to the matrix passing it to the range binaries. The range binaries cause the attenuator and indicators to DOWN RANGE when the units through 1K decades register a count of 0 and the 10K decade registers a count of 1. This unclamps the down signal supplied to the matrix which now passes a down signal to the range binaries.

Any down signal resets the range binaries to range 1 conditions from any other condition while an UP RANGE signal advances from 10 volt through 100 volt to the 1000 volt range sequentially.

POWER SUPPLY (See drawing 70-6004, page 6-7)

This assembly furnishes supply voltages for the instrument. These voltages are +230V, +35V, +25V, +23V, +11V, +1V and -36V. The +230V, +35V, +23V and -36V supplies are full wave bridge rectified, filtered and unregulated. The +25V, +11V and +1V supplies are full wave rectified, filtered and unregulated. Regulation of +25V and +11V is accomplished by circuits which are nearly identical except for component values Therefore only the +11V regulator will be discussed

Regulation is accomplished by passing transistor Q1, which is mounted on the chassis for efficient heat sink operation The regulated output is compared against the voltage across CR411, amplified by Q401 and fed to the base of Q1. Diodes CR404 and CR410 provide overload protection for the passing transistor Q1. Similarly, diodes CR412 and CR413 provide overload protection for Q401. Current for the zener regulator CR411 is obtained from the regulated +35V supply through R406.

REFERENCE (See drawing 70-0711-3, page 6-11)

The high degree of accuracy of the digital voltmeter is achieved by designing the 10 volt reference supply for long term stability. This is accomplished in part by aging the zeners and pre-regulators to the point where further drift effects are negligible. Further stability is achieved by efficient regulation of the reference supply.

Regulation is accomplished by a two terminal constant current source consisting of transistors Q1102 and Q1101 and resistors R1101 and R1102. The base bias of these transistors is held constant by zener diodes CR1103 and CR1104 and resistors R1101 and R1102. The constant current source is designed to allow a current of 15.1 milliamps to flow through it. 7.5 milliamps flow through the pre-regulator element CR1105, 7.5 milliamps flow through the final reference element CR1106, and 0.1 milliamp is fed to the output resistor network and to the precision potentiometer for use as internal reference voltage by the voltmeter. Two test points (TP1101 and TP1102) are provided for initial factory adjustment of the reference supply by means of the trimpot R1103.

CAUTION

Trimpot R1103 is factory adjusted and sealed and must not be tampered with. Trimpots R1107 and R1108 are available for adjustments through the top cover where they are labeled "COARSE" and "FINE". These may be adjusted to calibrate the reference voltage during routine maintenance.

PRINT CONTROL Models 7300A and 7500A (See drawing 70-0714, page 6-55)

This assembly has three functions: null detection, holding and print commanding. UP and DOWN drive pulses from the logic drive assembly are provided as inputs to the null detector. A one-shot multivibrator converts them to longer pulses.

When the print control assembly is in its static state with no input from the drivers, Q1401 is conducting, Q1402 cut off, and Q1404 and Q1405 are saturated, closing control relay K41. All other control relays are open. When the voltmeter is seeking a null, drive pulses are fed to the one-shot, the output of which turns off relay control transistors Q1404 and Q1405. While the one-shot is firing, a charge builds up across C1404. K41 is now open and capacitors C1407 and C1408 begin to charge. When a null is achieved by the voltmeter, the drive pulses are no longer present so that the charge across C1404 can bleed off through R1406 and R1407 which are adjustable to control the discharge time. This delay time is required to insure that the voltmeter has reached a true null. When C1404 is discharged, Q1404 and Q1405 turn on again closing R41. This provides a ground return for C1407 and it discharges through K42 and K45 momentarily closing them and shorting the gate line to impress a hold on the voltmeter during printout. The contacts of K42 and K45 also provide a ground return for C1408 momentarily closing K43 to issue a print command. As the two relay control capacitors are discharged K42 and K43 relax and the hold is removed from the voltmeter gate.

DOWN RANGE CONTROL (See drawing 70-0721, page 6-59)

This assembly consists of a printed circuit board installed in the voltmeter directly under the power transformer. The sole function of the assembly is to furnish a down range signal to the plug-in assemblies, for example, the AC Converter, whenever the readout is indicating a number less than 9.9% of full scale. Figure 5-5 is a block diagram of this assembly.

When the assembly is in its stable state with no input from the 10K, 1K or the 100 decades, transistor Q2103 is normally turned on and furnishes forward bias to the base of Q2104. Q2105 is normally turned off so that no supply voltage is available to Q2104. Q2101 and Q2102 are normally turned off. Figure 5-5 shows Down Range Control logic.

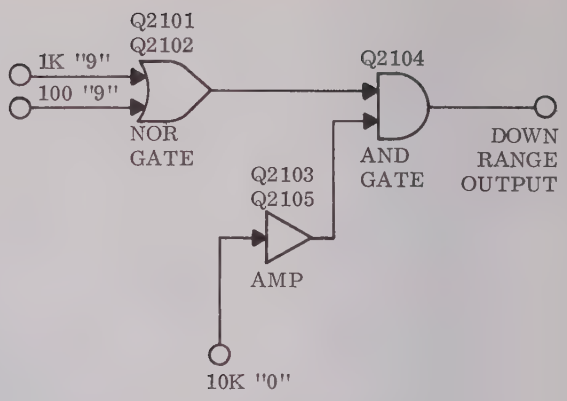


Figure 5-5. Logic Representation of Down Range Control.

In order for this assembly to produce a down range output, it is necessary for the 10K decade to register 0 and either or both of the 1K and 100 decades must register other than 9. When the 10K decade is registering 0, it furnishes circuit common through CR2103 and resistor R2113 to the base of Q2105 Q2105 becomes saturated and supplies positive collector potential to Q2104 which also saturates, unless either or both the 1K and 100 decade is registering a count other than 9, Q2101 and Q2102 will be conducting and Q2104 will be cut off. The voltage potential at the collector of Q2104 will rise and C2101 will begin to charge. After a period of 3 to 4 seconds, this control voltage will reach a sufficiently high level to reset the plug-in assembly to its lowest range. If circuit common is returned to both 1K and 100 inputs, Q2101 and Q2102 will both turn on, saturating Q2104. It is necessary for one of these inputs to be not circuit common (i.e., the decades to be in other than the 9 count) in order for Q2104 to remain turned off. This insures that a down range signal is given only when required.

DETAIL LOGIC

An important troubleshooting aid in these instruments is a thorough knowledge of the logic, that is, the

sequence followed in going from any one reading to any other. Large input changes nearly always cause all three drive systems, UP, FAST UP, and DOWN, to operate. However, an assumed uninterrupted series of pulses from a single drive at a time is simpler to explain. The explanation is followed by examples.

UP DRIVE ONLY

Assume an initial reading of 0.0000, and an input voltage of 1000V. Beginning with the units (rightmost) each decade will count to 9, then on the next pulse, hole 9 count but advance to S9 (shift-9) condition until a reading of 9.9999 is reached. The next pulse fires the up-range one-shot which drives the range to 99.999. The next pulse advances the range to 999.99. At regular intervals, the range will alternate between the 100 and 1000 volt scales, indicating an input voltage in excess of the capabilities of the instrument.

FAST-UP DRIVE WITH UP DRIVE

For large increases in signal, the fast-up also drives at the same time as the normal up drives. In this instance, the normal counting is shortened by a direct setting of 9 in the units, then a second pulse sets S9. In the same way, the tens and hundreds decades are also advanced to S9 for a total of 6 pulses rather than 30. If the panel sensitivity control is used to reduce sensitivity, the fast-up is lost because of dynamic range limitations. In the examples, the fast-up can be ignored, as the logic remains the same without it, except for total number of pulses.

DOWN DRIVE ONLY

The down drive logic is more complicated than the up system, since the exact order of changing depends upon the range and reading.

The basic sequence of operation is this: first clear to zero any decade in an S9 state, starting with the most significant. Then, after no decade is in an S9 condition, clear each decade to zero starting with the least significant. To illustrate the first operation, assume a reading of +5.8(S9)(S9)(S9).

The order is:

+5.80(S9)(S9)
+5.800(S9)
+5.8000
+5.0000
+0.0000

To illustrate the second operation, assume a reading of +5.8321:

+5.8320
+5.8300
+5.8000
+5.0000
+0.0000

At a reading of 0.0000, the next pulse reverses polarity and since this also leaves a reading of 0.0000, the polarity continues to reverse with each new pulse. Tables 5-2 and 5-3 show step by step counting logic for different input conditions.

A special case occurs when the range is at 100 or 1000 volts. For this condition, the ten-thousands decade clears to 1 instead of zero. The other decades are cleared in the normal manner. At a reading of 10.000 or 100.00, the next pulse drops the range to 10 volts for a reading of 1.0000. The next pulse clears the 1 to 0 for a reading of 0.0000. This is followed by the pularity reversals. The reason for this seemingly odd logic is the necessity for generating a down-range signal. As described in the paragraph RANGE AND POLARITY, a down-range signal is generated when the units through 1K decades register a count of 0 and the 10K decade registers a count of 1. Thus, any input less than 100 volts is approached from the mist sensitive scale and best resolution is obtained.

Table 5-2. Counting Logic With Polarity Change.

NUMERICAL DIRECTION	READOUT	NUMBER OF PULSES
INPUT	-234.05, then reverse polarity to +234.05	
DOWN	-234.00	1
DOWN	-230.00	1
DOWN	-200.00	1
DOWN	-100.00	1
DOWN	-1.0000	1
DOWN	-0.0000	1
DOWN	+0.0000	1
UP	+0.000(S9)	2 with UP and F-UP
UP	+0.00(S9)(S9)	2 with UP and F-UP
UP	+0.0(S9)(S9)(S9)	2 with UP and F-UP
UP	+0.(S9)(S9)(S9)(S9)	10
UP	+(S9).(S9)(S9)(S9)(S9)	10
UP	+(S9)(S9).(S9)(S9)(S9)	1
UP-RANGE One-Shot delays approximately 20 pulses with Filter OUT (100 pulses with Filter IN).		
UP	+(S9)(S9)(S9).(S9)(S9)	1
DOWN	+1(S9)(S9).(S9)(S9)	1
UP	+2(S9)(S9).(S9)(S9)	1
DOWN	+20(S9).(S9)(S9)	1
UP	+23(S9).(S9)(S9)	8
DOWN	+230.(S9)(S9)	1
UP	+234.(S9)(S9)	4
DOWN	+234.0(S9)	1
DOWN	+234.00	1
UP	+234.05	5 and null

Note: (S9) indicates that the 9 displayed is in the shift condition.

Table 5-3. Counting Logic for Small Voltage Change.

NUMERICAL DIRECTION	READOUT	NUMBER OF PULSES
INPUT	+2.3456 changing to +2.5432	
UP	+2.345(S9)	2 with UP and F-UP
UP	+2.34(S9)(S9)	2 with UP and F-UP
UP	+2.3(S9)(S9)(S9)	2 with UP and F-UP
UP	+2.5(S9)(S9)(S9)	2
DOWN	+2.50(S9)(S9)	1
UP	+2.54(S9)(S9)	4
DOWN	+2.540(S9)	1
UP	+2.543(S9)	3
DOWN	+2.5430	1
UP	+2.5432	2 and null

Note: (S9) indicates that the 9 displayed is in the shift condition.

SECTION VI

MAINTENANCE

TABLE OF CONTENTS

Paragraph	Page
INTRODUCTION	6-1
DISASSEMBLY FOR MAINTENANCE	6-2
TROUBLESHOOTING	6-2
INTERCHANGEABILITY	6-2
POWER SUPPLY	6-5
REFERENCE	6-9
ATTENUATOR AND PRE-AMP	6-13
AMPLIFIER	6-17
LOGIC DRIVER	6-21
LOGIC MATRIX	6-25
UNITS THROUGH 1K DECADE	6-29
10K DECADE	6-33
RANGE AND POLARITY	6-37
"A" POTENTIOMETER	6-41
"B" POTENTIOMETER	6-45
REMOTE FUNCTION	6-49
PRINT CONTROL	6-53
DOWN RANGE CONTROL	6-57
SUB ASSEMBLIES	6-62

INTRODUCTION

Troubleshooting of the instrument is extremely simple. Since the majority of components in the instrument are mounted on plug-in boards, troubleshooting is reduced to systematically replacing existing boards with spare boards until the defect is remedied. In this manner down time is reduced to a very few minutes. Faulty boards can be repaired at the user's facility or returned to CIMRON or a CIMRON representative for repair. The user of the Series 7000A is urged to thoroughly familiarize himself with the operation of the instrument before any troubleshooting is attempted.

Pages 6-5 through 6-57 contain information on all plug-in boards. Each board is treated separately. The information for each board is contained in four consecutive pages: a description of the board is provided on the first page, a component location guide is provided on the second page, a schematic of the board with waveforms and voltages is provided on the third page and a list of all replaceable electronic parts is given on the fourth page. Encircled numbers on the schematic adjacent to each waveform refer to the procedures for setting up the voltmeter and oscilloscope to obtain the particular waveforms. The procedures are found adjacent to identical and encircled numbers below the schematic diagram. Pages 6-7 through 6-56 contain schematics showing board interconnections.

The slots into which the various boards fit into the instrument are assigned a number. This number is marked on the rail adjacent to the slot. The number also appears on the plug-in board itself. In replacing boards it is necessary only to match the board number with the number on the rail. This should preclude any possibility of replacing a board in an improper slot once it has been removed.

Since many of the components used in the instrument are standard electronic parts, the user may

obtain them locally if desired. However, it is recommended that precision components and mechanical parts be ordered from the CIMRON representative or direct from the factory.

When replacing components on a printed circuit board, care should be taken to prevent damage to the board from excessive heat. A low wattage soldering iron is recommended for soldering operations on the board or when removing or replacing transistors. Whenever practicable, a heat sink should be used between the soldering point and the transistor body.

DISASSEMBLY FOR MAINTENANCE

The disassembly of the voltmeter for maintenance or for troubleshooting is accomplished as follows:

1. Top Cover. Remove four oval head countersunk phillips head screws securing the top cover to the instrument and remove the cover. A spring-loaded bullet catch is provided to lift one side of the cover away from the instrument to aid in removal.

2. Bottom Cover. Remove four oval head countersunk phillips head screws and remove the bottom cover.

3. Inner Guard Shields. There are two guard shields in the unit, upper and lower. The upper guard shield is further divided into two sections, front and rear. The front section is secured to the instrument by six 4-40 pan head screws. The rear shield is secured by three 4-40 pan head screws. Normal maintenance and adjustment may be accomplished by removing only the front shield.

4. Plug-in Board Removal. It it is necessary to remove a plug-in board for repair or replacement, always use the wire board puller which is located in a mounted bracket under the front guard shield. Insert the board puller from the component side of the board and pull straight out.

CAUTION

Power should be off when removing or replacing board assemblies.

5. Neon Display Tube Removal. Remove the two allen head screws and one of the polarized retainers. The display polarizer may then be snapped out of the front panel. An octal vacuum tube puller may be used to remove the neon display tube. After the Display tube is replaced, insert the polarizer first into the still attached retainer and then spring it into position along the opening in the front panel. When nearly into position, slip on the retainer which was removed, position it into place, and replace the screws.

TROUBLESHOOTING

The voltage measurements and wave shapes necessary to indicate proper operation of a plug-in board are listed on the applicable schematic diagrams. These diagrams are placed in the manual in a logical sequence of trouble isolation. Failure to obtain the required voltages or wave shapes usually will indicate which plug-in board is defective. Its replacement should restore the voltmeter to its normal specified operation. Replacement of the preamplifier, amplifier, logic driver, or reference assemblies will require complete recalibration of the instrument. The procedure for recalibration is outlined in Section IV of this manual.

INTERCHANGEABILITY

The plug-in boards used in the Series 7000A are completely interchangeable with the exception of the "A" Potentiometer Assembly, CIMRON part number 70-6012, which must be changed as a set. To satisfy the linearity requirements of the instruments, the ratio of the resistors installed on these boards must be maintained. Boards having the same slot number, however, may be removed and reinstalled without regard for their original positions.

PRINT CONTROL ASSY 70-6014
REFERENCE ASSY 70-6011
"B" POTENTIOMETER ASSY 70-6013
"A" POTENTIOMETER ASSY 70-7012
ATTEN & PREAMP ASSY 70-6006
AMPLIFIER ASSY 70-6009
LOGIC DRIVER ASSY 60-6008
LOGIC MATRIX ASSY 70-6001
RANGE & POLARITY ASSY 70-6007
10K DECADE ASSY 70-6003
UNITS THROUGH 1K DECADE ASSY 70-6002
READOUT FUNCTION ASSY 70-6005
POWER SUPPLY ASSY 70-6004

Figure 6-1. Top View Showing Plug-in Board Location.

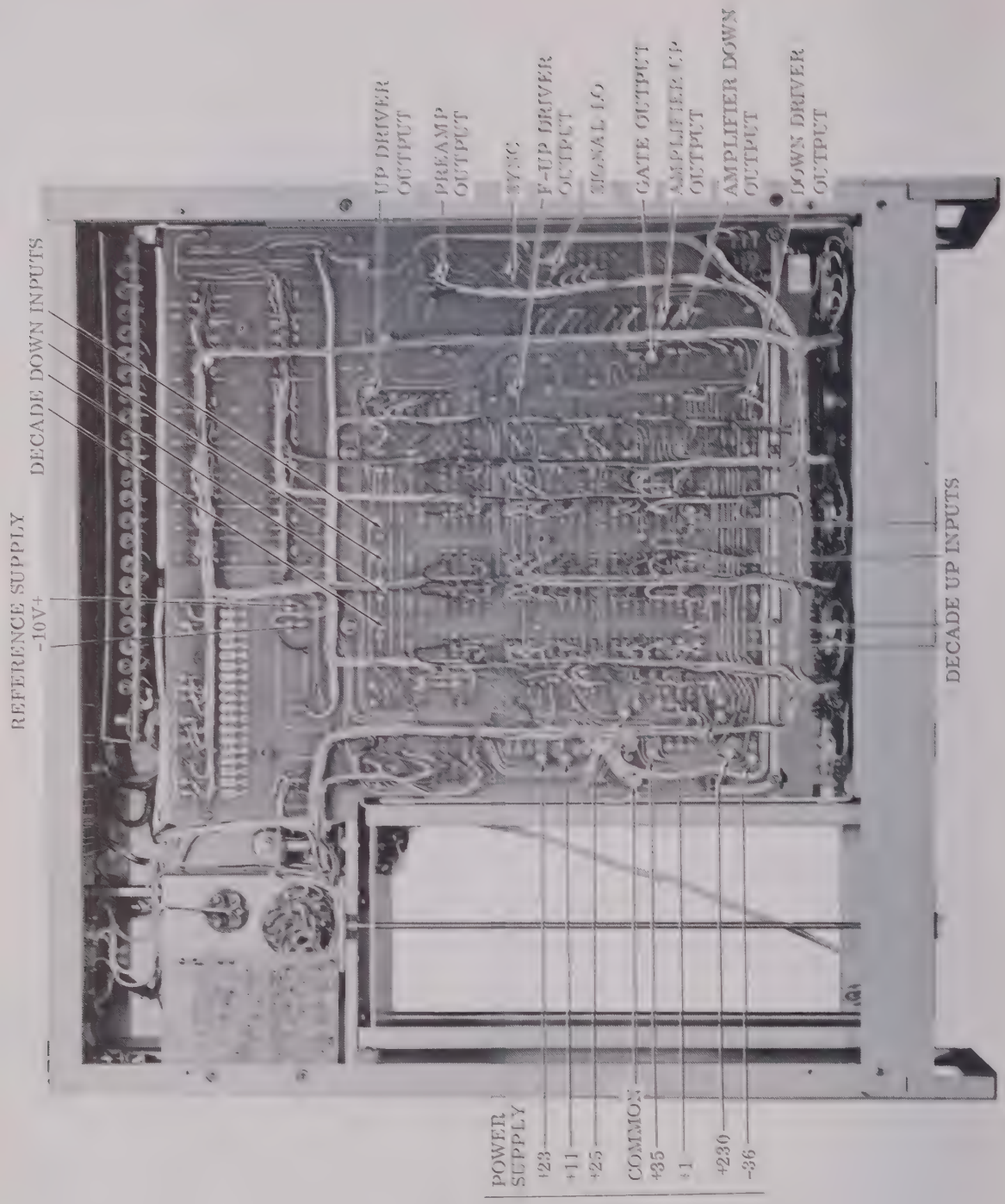


Figure 6-2. Bottom View Showing Test Points.

POWER SUPPLY

ASSEMBLY 70-6004

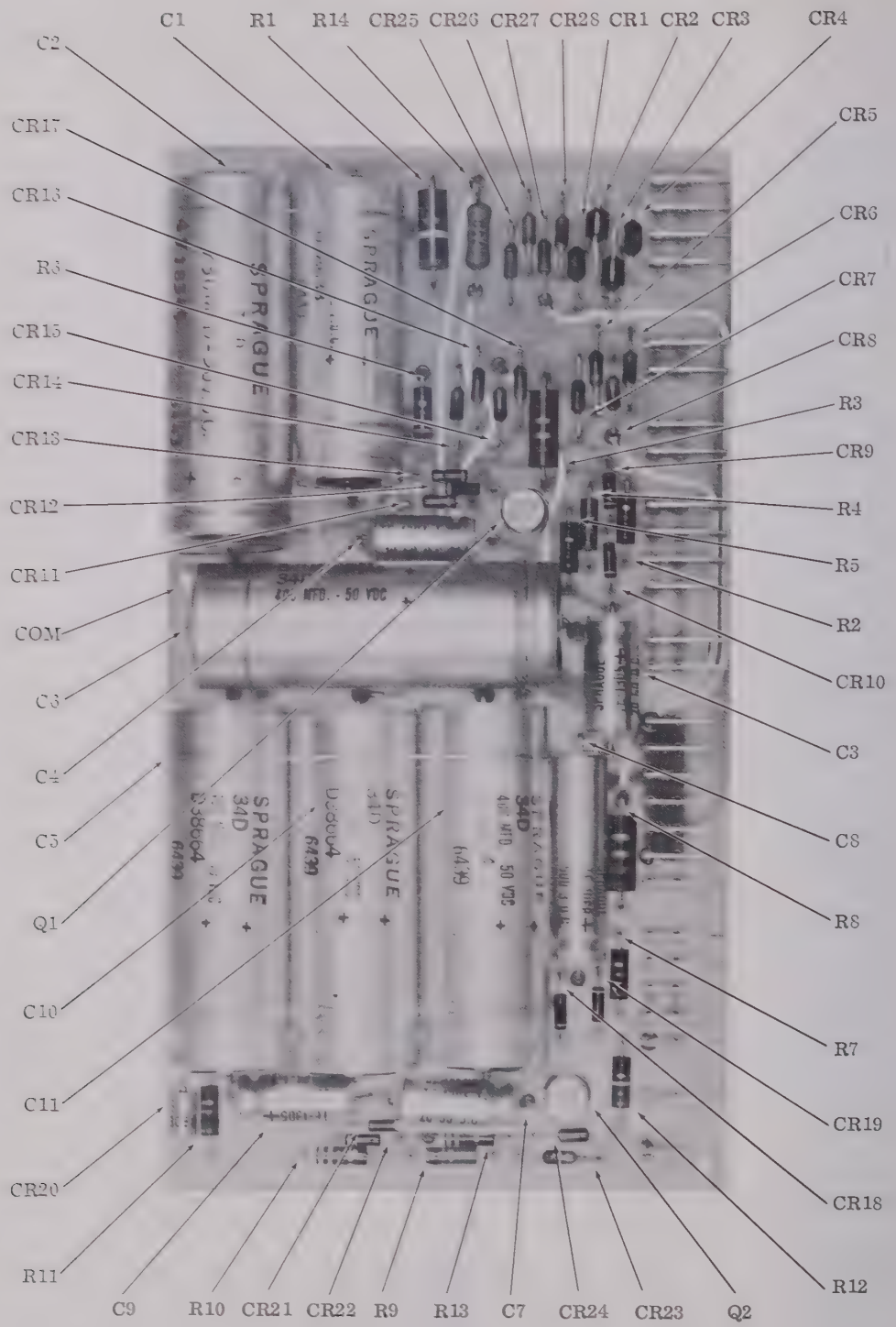
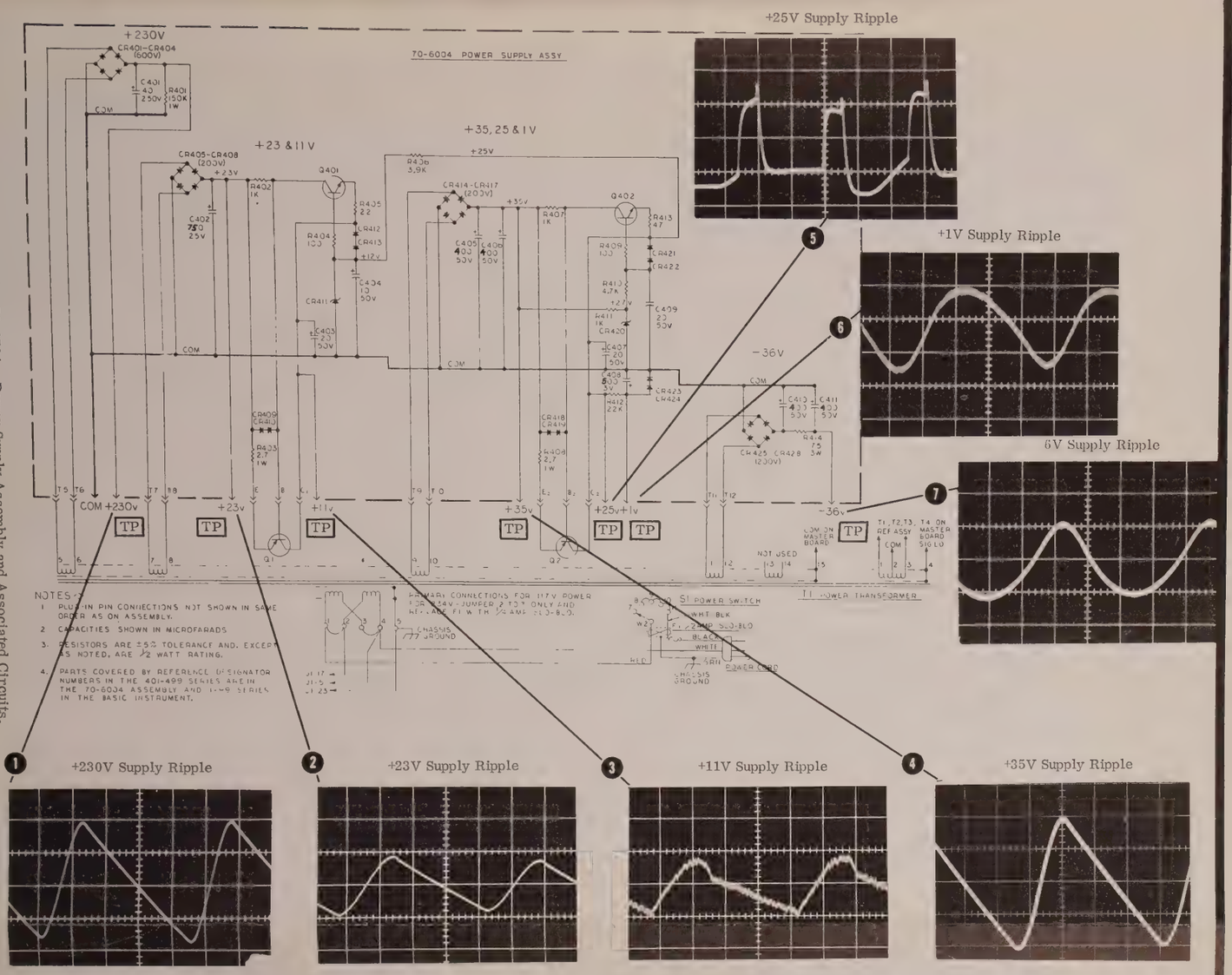


Figure 6-3. Power Supply Assembly.



Schematic Drawing 70-0704, Power Supply Assembly and Associated Circuits.

Digital Voltmeter and Oscilloscope Settings

❶❷❸❹❺❻❼	POWER switch:	ON	
	SENSITIVITY control:	HI	VOLTMETER
	PRINT CONTROL switch:	AUTO	
	FUNCTION switch:	DC	
	DC RANGE switch:	AUTO	
❶❷❸❹❺❻❼	TRIGGER SELECTOR:	+LINE	
	SWEEP RATE:	2 ms/cm	
	VERTICAL AMPLIFIER:	AC COUPLED	
❶❷	SENSITIVITY:	0.5 v/cm	
❸		0.5 mv/cm	OSCILLOSCOPE
❹		0.2 v/cm	
❺		2.0 mv/cm	
❻		0.2 mv/cm	
❼		5.0 mv/cm	

❶ Requirement: +253V DC ±11 volts with less than 2.5 volt 120 cps ripple.

❷ Requirement: +22V DC ±4 volts with less than 2.0 volt 120 cps ripple.

❸ Requirement: +11V DC ±2 volt with less than 5 mv 120 cps ripple.

❹ Requirement: +35V DC ±6 volts with less than 2.0 volts 120 cps ripple.

❺ Requirement: +25V DC ±5.0 volts with less than 15 mv 120 cps ripple.

❻ Requirement: +1.5V DC ±0.30 volts with less than 15 mv 120 cps ripple.

❼ Requirement: -34V DC ±5 volts with less than 20 mv 120 cps ripple.

REFERENCE

ASSEMBLY 70-6011-3

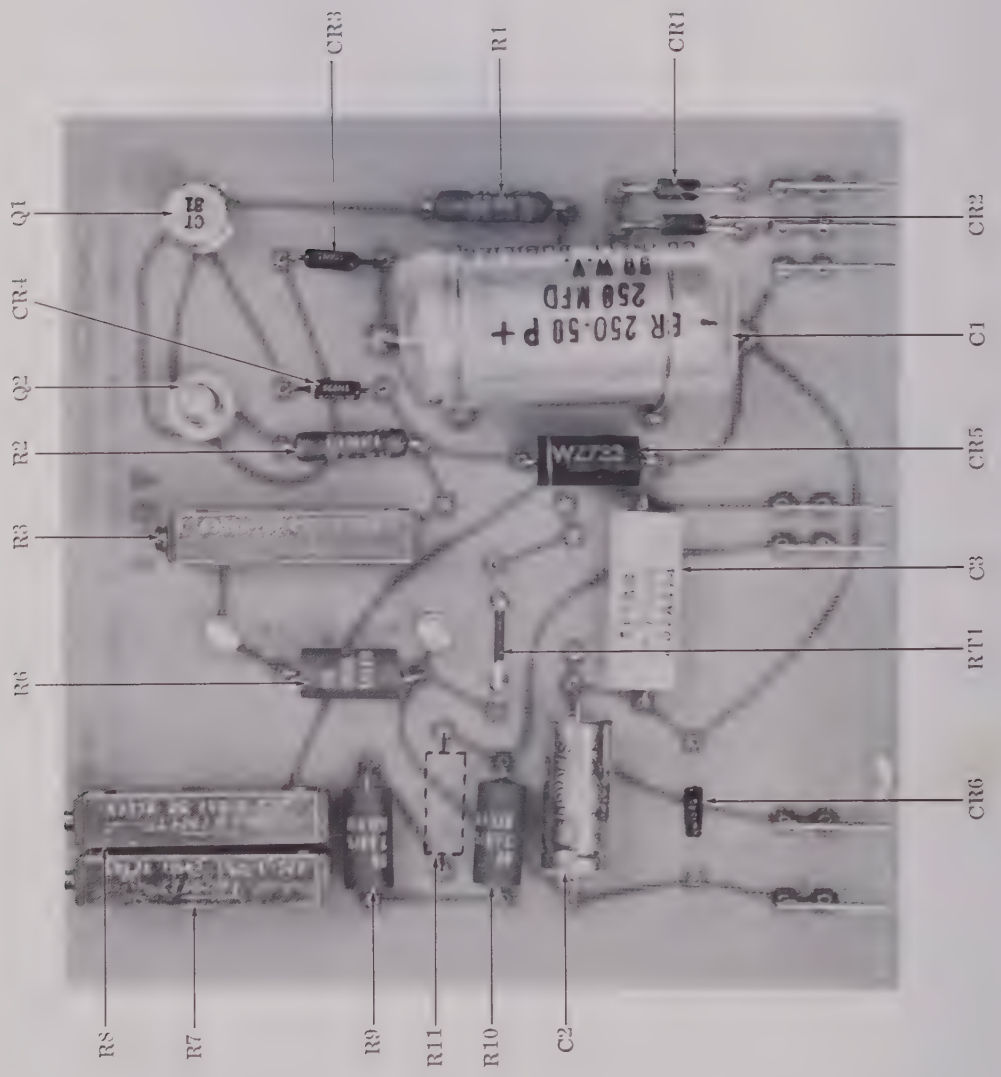
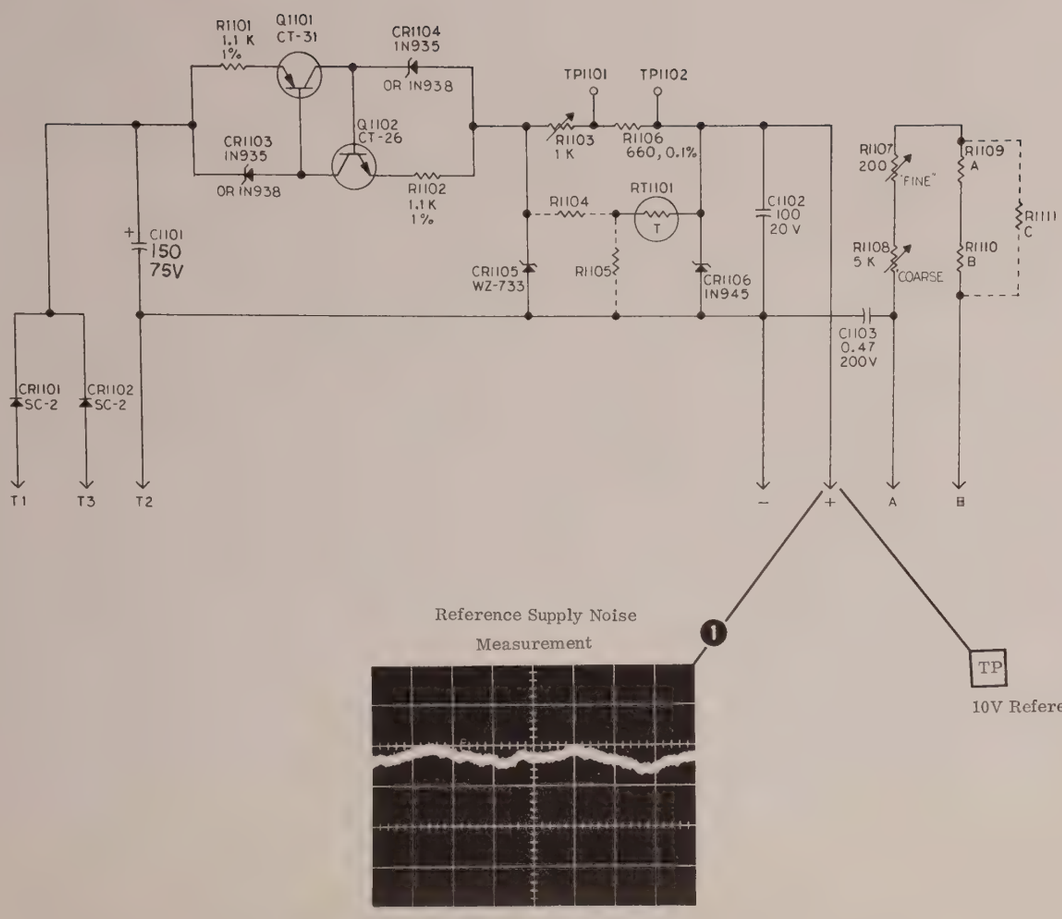
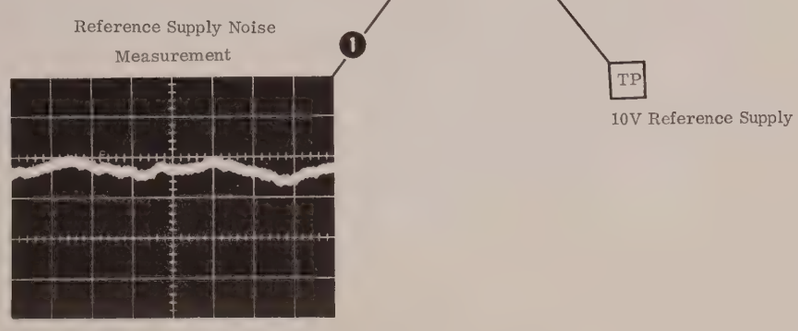


Figure 6-4. Reference Assembly.

Schematic Drawing 70-0711-3. Reference Assembly.





Digital Voltmeter and Oscilloscope Settings

1	POWER switch:	ON	VOLTMETER
	SENSITIVITY control:	HI	
	FUNCTION switch:	DC	
	DC RANGE switch:	10	
1	TRIGGER SELECTOR:	+LINE	OSCILLOSCOPE
	SWEEP RATE:	20 msec/cm	
	VERTICAL AMPLIFIER:	AC COUPLED	
	SENSITIVITY:	0.1 mv/cm	

1 Requirement: Approximately 10V DC with less than 0.3 mv ripple.

ATTENUATOR AND PRE-AMP

ASSEMBLY 70-6006

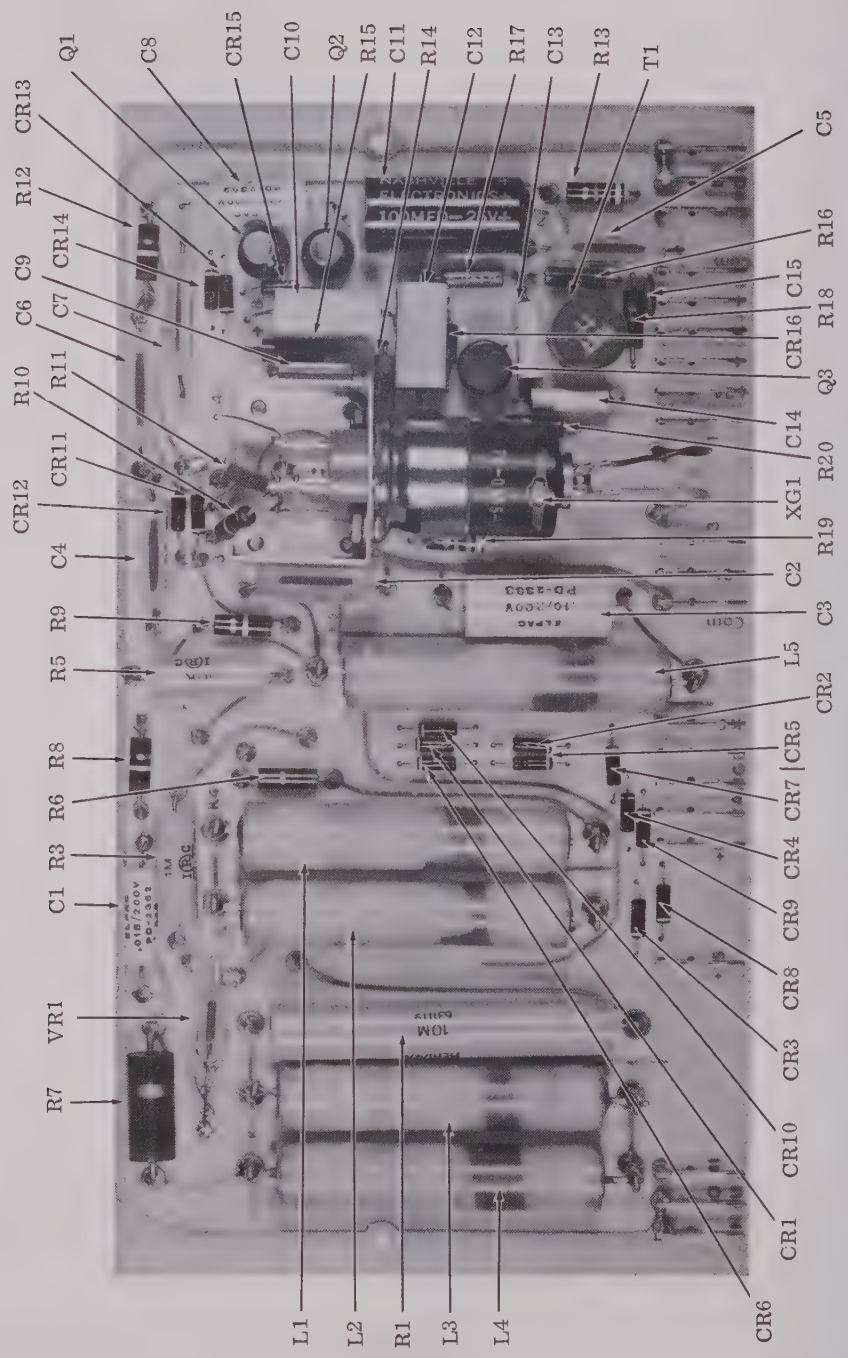
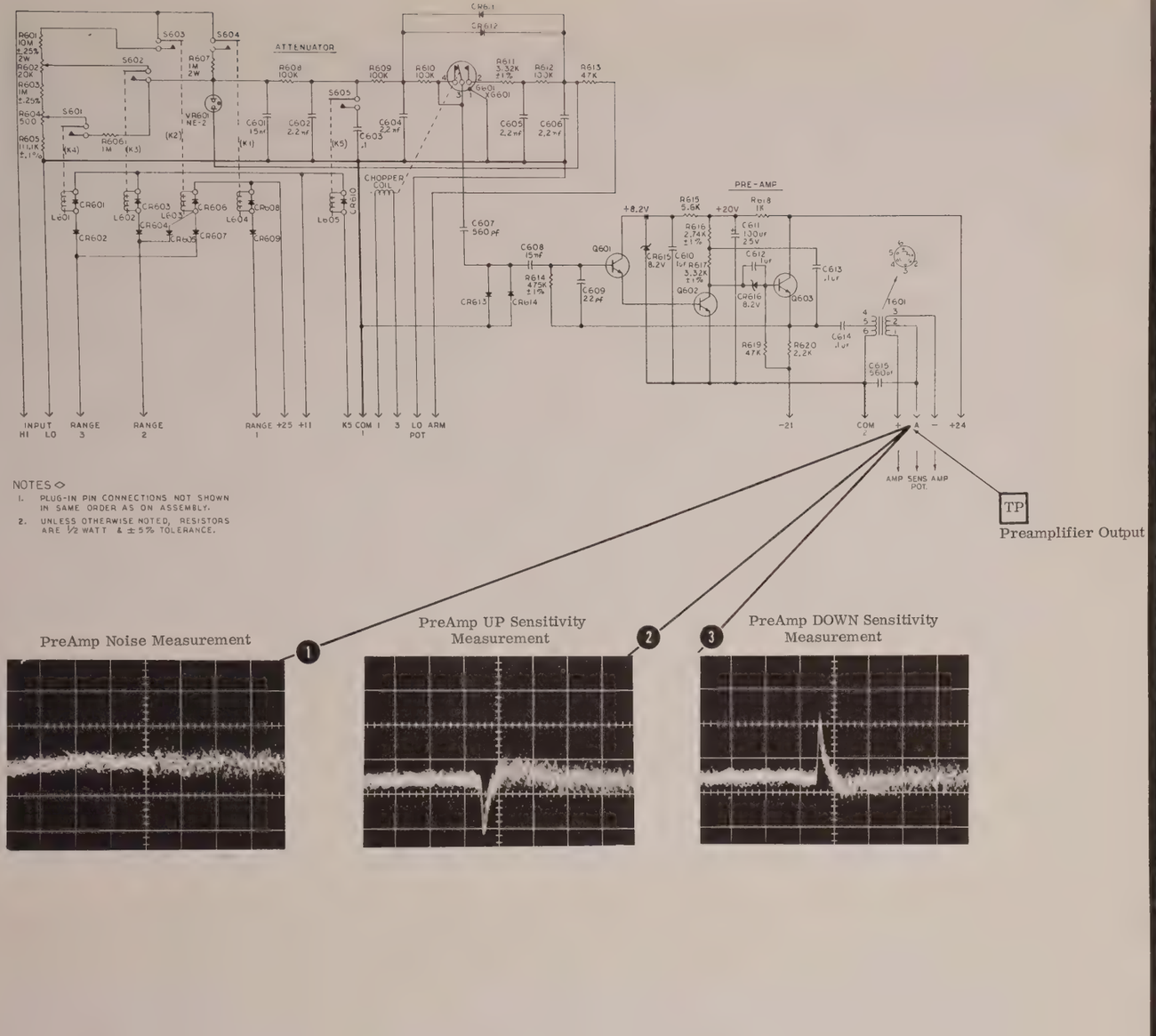


Figure 6-5. Attenuator and PreAmp Assembly.



Schematic Drawing 70-0706. Attenuator and PreAmp Assembly.

PreAmp Noise Measurement

PreAmp UP Sensitivity Measurement

PreAmp DOWN Sensitivity Measurement

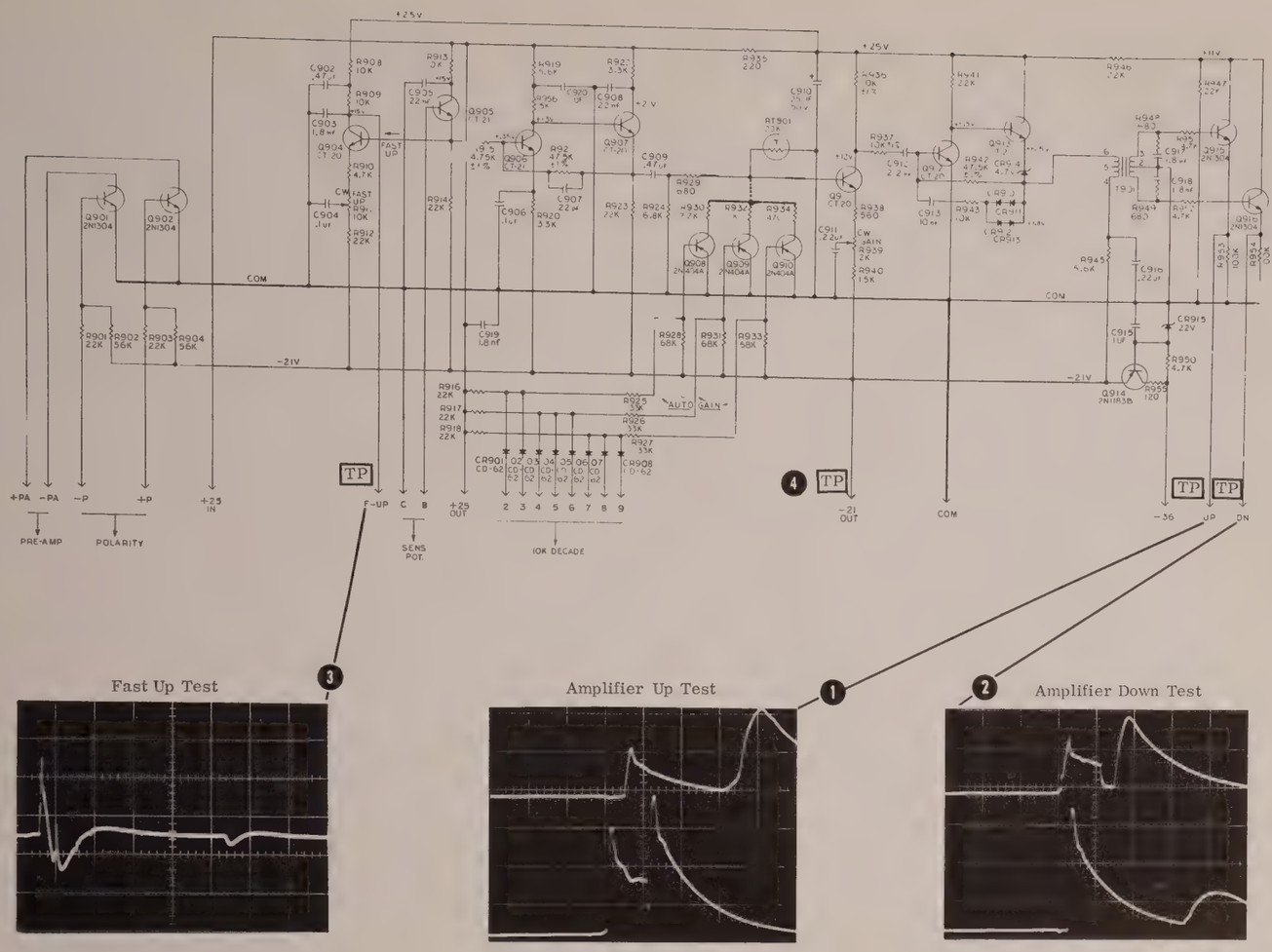
Digital Voltmeter and Oscilloscope Settings

1 2 3	POWER switch:	ON	
	SENSITIVITY control:	HI	VOLTMETER
	FUNCTION switch:	DC	
	DC RANGE switch:	10	
1 2 3	TRIGGER SELECTOR:	+LINE	
	SWEEP RATE:	50 μsecs/cm	OSCILLOSCOPE
	VERTICAL AMPLIFIER:	AC coupled	
	SENSITIVITY:	1 mv/cm	

1. Short black and red voltmeter input leads together. Noise measurement should not be in excess of 2.5 mv.

2. Introduce an UP error of 80 microvolts to DVM input. Output pulse should be approximately 3 mv.

3. Introduce a DOWN error of 80 microvolts to DVM input. Output pulse should be approximately 3 mv.



Fast Up Test

Amplifier Up Test

Amplifier Down Test

Schematic Drawing 70-0709. Amplifier Assembly.

Digital Voltmeter and Oscilloscope Settings

1 2 3	POWER switch:	ON	
	SENSITIVITY control:	HI	VOLTMETER
	FUNCTION switch:	DC	
	DC RANGE switch:	10	
1 2 3	TRIGGER SELECTOR:	+LINE	
	SWEEP RATE:	0.1 us/cm	OSCILLOSCOPE
	VERTICAL AMPLIFIER:	AC COUPLED	
	SENSITIVITY:	5 v/cm	

1. Remove Logic Matrix plug-in board. Provide 100 uv UP error to input of DVM. Connect upper beam of oscilloscope to test point AMPLIFIER DOWN. Connect lower beam of oscilloscope to lower beam of oscilloscope to test point AMPLIFIER UP. Observe oscilloscope traces similar to those in Amplifier UP test above. Note that the UP pulse leads the DOWN pulse by approximately 0.02 usec.

2. With matrix board removed and oscilloscope connected as above, introduce a 100 uv DOWN error to the input of the DVM. Observe oscilloscope traces similar to those in Amplifier DOWN test above. Note that DOWN pulse leads the UP pulse by approximately 0.02 usec.

3. With matrix board removed, provide a 150 uv UP error to the DVM. Connect one beam of the oscilloscope to test point AMPLIFIER FAST UP. Observe a positive pulse of approximately 10 volts.

4. Voltage Measured should be -21V ±4V. Ripple should not exceed 0.75 mv.

LOGIC DRIVER

ASSEMBLY 70-6008

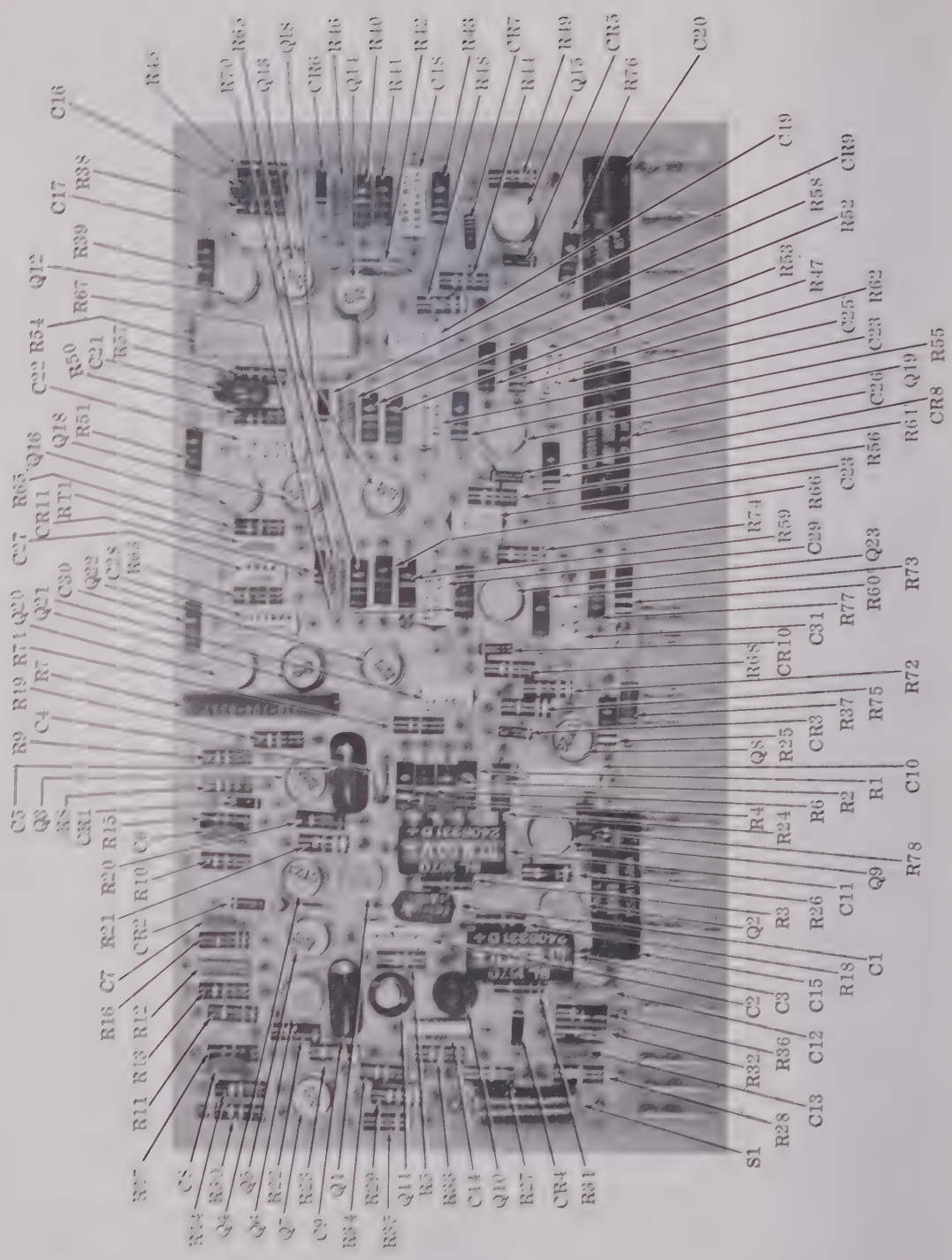
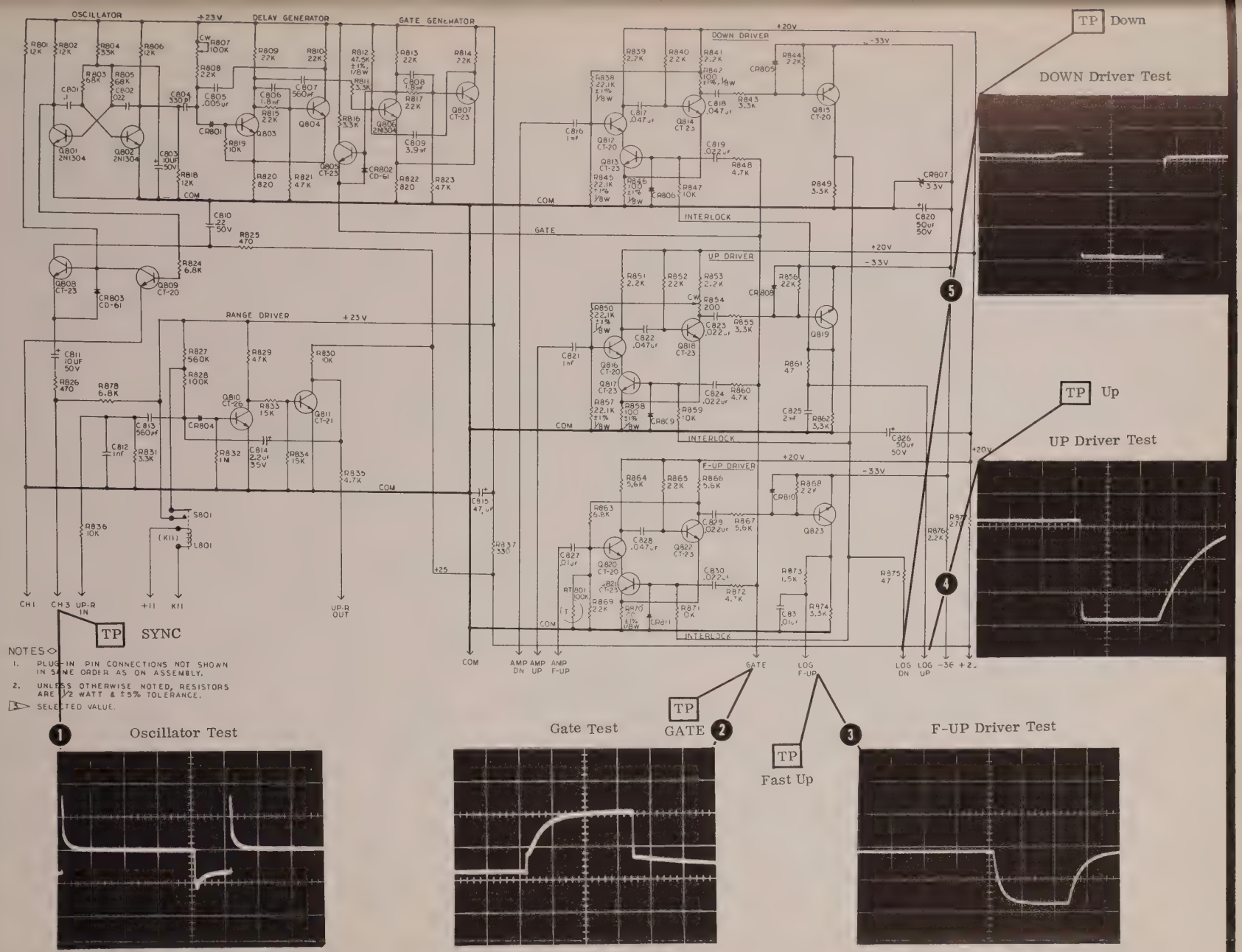


Figure 6-7. Logic Driver Assembly.



Schematic Drawing 70-0708. Logic Driver Assembly.

Digital Voltmeter and Oscilloscope Settings

1 2 3 4 5	POWER switch:	ON	VOLTMETER
	SENSITIVITY control:	HI	
	FUNCTION switch:	DC	
	DC RANGE switch:	10	
1 2 3 4 5	TRIGGER SELECTOR:	+LINE	OSCILLOSCOPE
1	SWEEP RATE:	1 ms/cm	
2 3 4 5		50 us/cm	
	VERTICAL AMPLIFIER:	AC COUPLED	
1 3 4 5	SENSITIVITY:	10v/cm	
2		5v/cm	

1. Connect vertical oscilloscope input to SYNC test point on bottom of voltmeter.
Requirement: negative pulses 10-20V approximately 1 ms wide spaced approximately 4 ms.

2. Connect vertical oscilloscope input to GATE test point.
Requirement: positive pulse approximately 10 volts, approximately 150 us wide.

3. Remove logic matrix board (to keep DVM from nulling error input.) Provide 150 mv UP error voltage to input of DVM. Connect oscilloscope to DRIVER OUT FAST UP test point. Requirement: Approximately 20V negative pulse.

4. With logic matrix board removed, provide 100 mv UP error voltage at input of DVM. Connect oscilloscope to DRIVER OUT UP test point. Requirement: negative pulse approximately 30 volts.

5. With logic matrix board removed, provide 100 mv DOWN error voltage at input of DVM. Connect oscilloscope to DRIVER OUT DOWN test point. Requirement: negative pulse approximately 30 volts.

LOGIC MATRIX

ASSEMBLY 70-6001

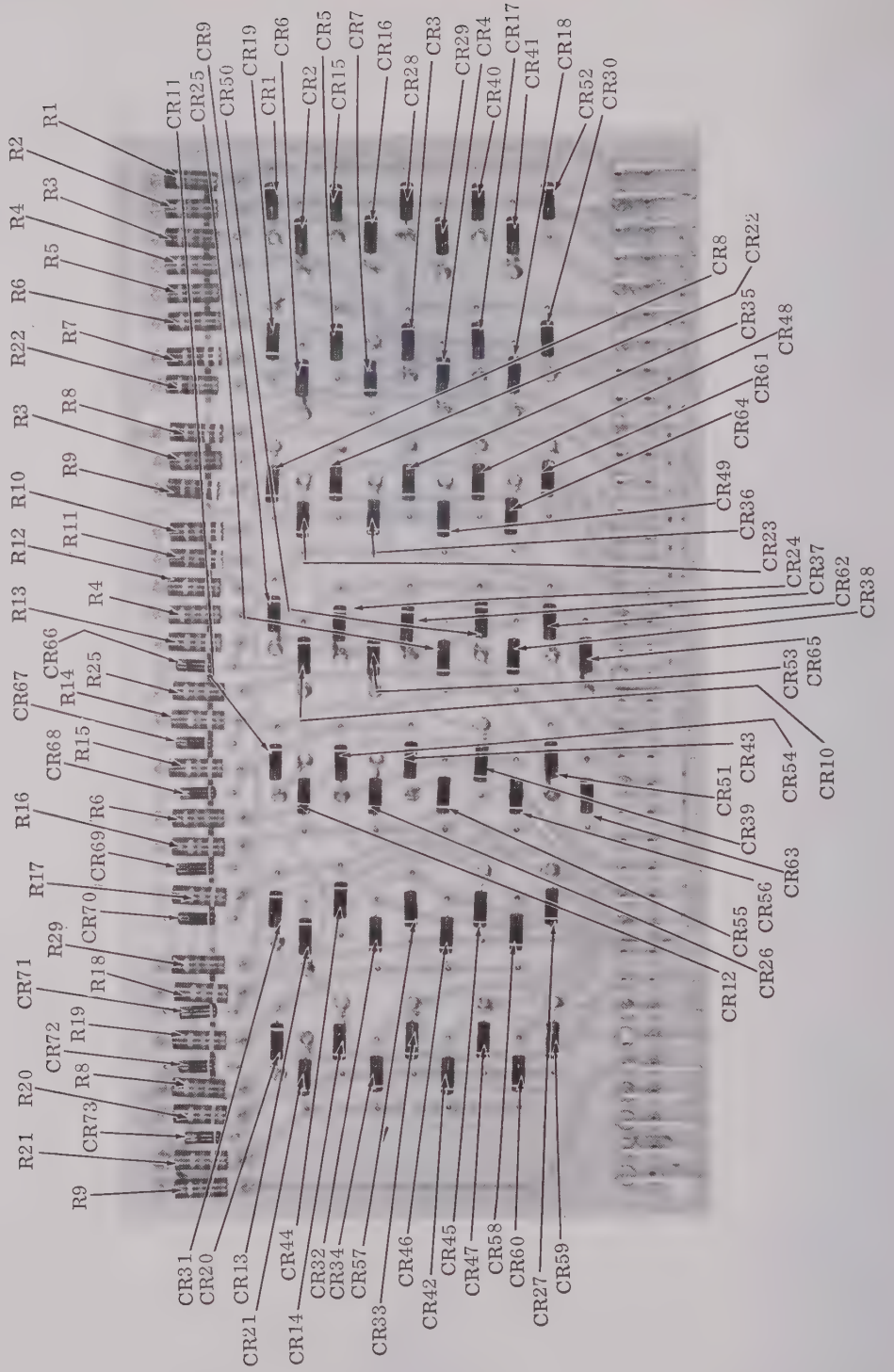
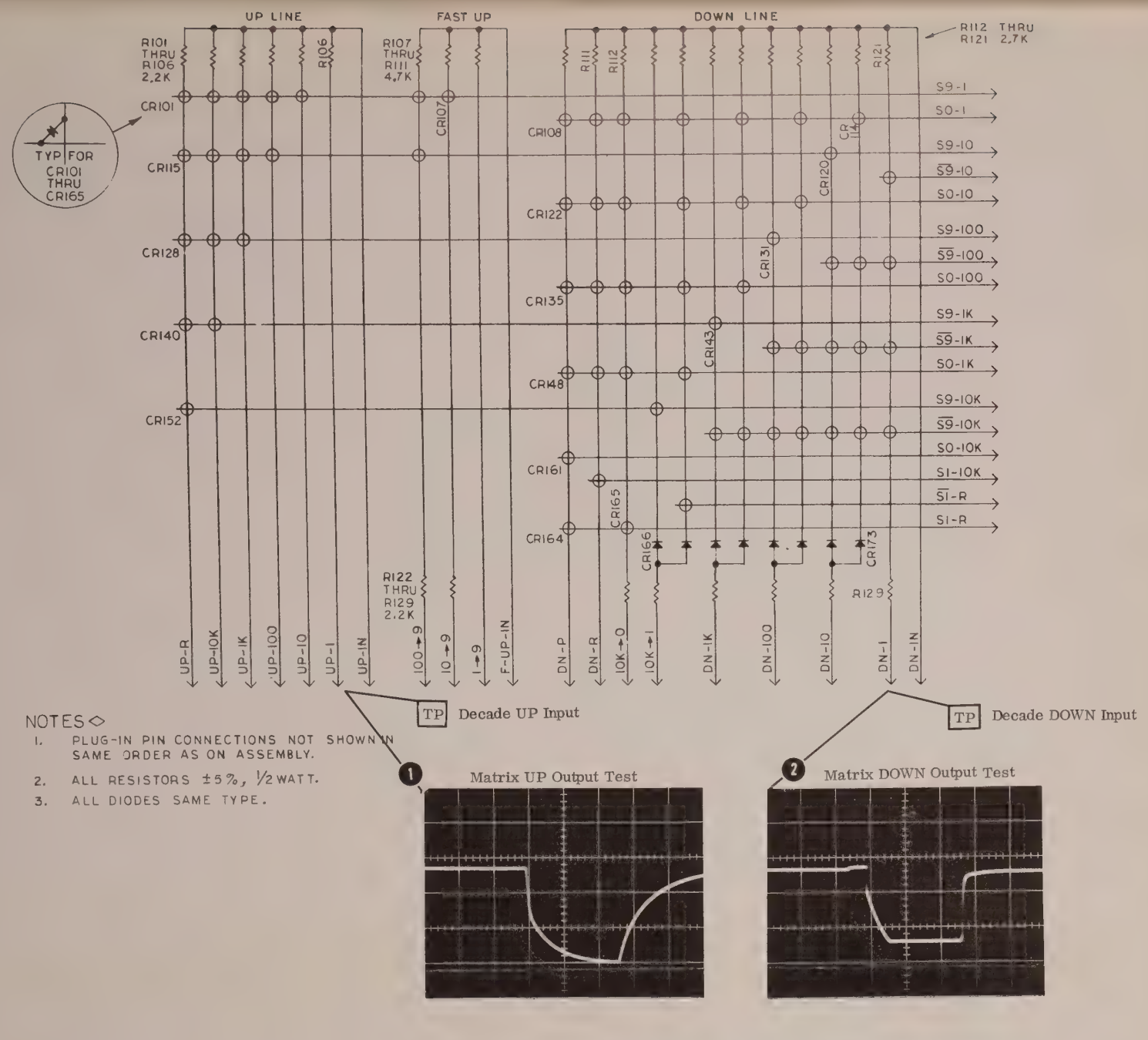


Figure 6-8. Logic Matrix Assembly.



NOTES ◇

1. PLUG-IN PIN CONNECTIONS NOT SHOWN IN SAME ORDER AS ON ASSEMBLY.
2. ALL RESISTORS ±5%, ½ WATT.
3. ALL DIODES SAME TYPE.

❶ Matrix UP Output Test

❷ Matrix DOWN Output Test

Schematic Drawing 70-0701. Logic Matrix Assembly.

Digital Voltmeter and Oscilloscope Settings

❶ ❷	POWER switch:	ON	
	SENSITIVITY control:	HI	
❶	FUNCTION switch:	-RATIO	VOLTMETER
❷		+RATIO	
	DC RANGE SWITCH:	AUTO	
❶ ❷	TRIGGER SELECTOR:	+LINE	
	SWEEP RATE:	50 usec/cm	OSCILLOSCOPE
	VERTICAL AMPLIFIER:	AC COUPLED	
❶	SENSITIVITY:	10 v/cm	
❷		5 v/cm	

❶ Place FUNCTION switch on DVM to RATIO+REF. Connect reference input leads to ground. Provide a +1 volt input to the DVM. Connect oscilloscope to TP UP input of UNITS decade. Observe negative pulse of approximately 30 volts. Requirements; This pulse should be present at UP inputs on each decade (See figure 6-2). The decades should indicate 999.99 count. If this count is not achieved, replace the decade board where the faulty indication first appears. If this does not correct fault, replace logic matrix assembly.

❷ Place FUNCTION switch to RATIO-REF. Connect reference input lead to ground. Provide a +1 volt input to the DVM. Connect oscilloscope to TP DOWN input of UNITS decade. Observe negative pulse of approximately 10 volts. Requirements: This pulse should be present at DOWN input on each decade (See figure 6-2). The decades should indicate a 0.0000 count. If this count is not achieved replace the decade where faulty indication first appears. If this does not correct fault, replace logic matrix assembly. Failure of range assembly to reach basic range could also cause erroneous reading, indicating malfunction in Range and Polarity Assembly.

UNITS THROUGH 1K DECADE

ASSEMBLY 70-6002

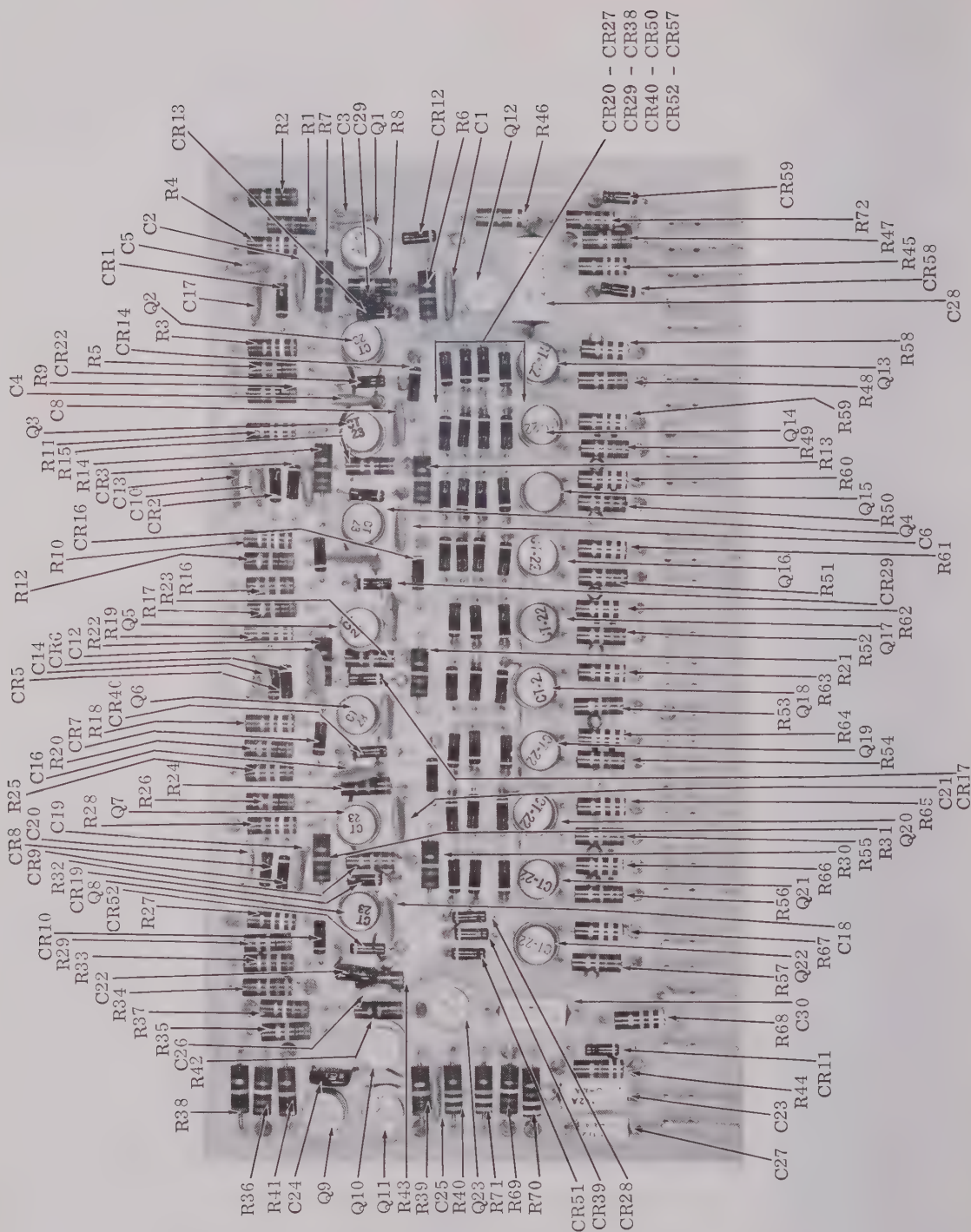
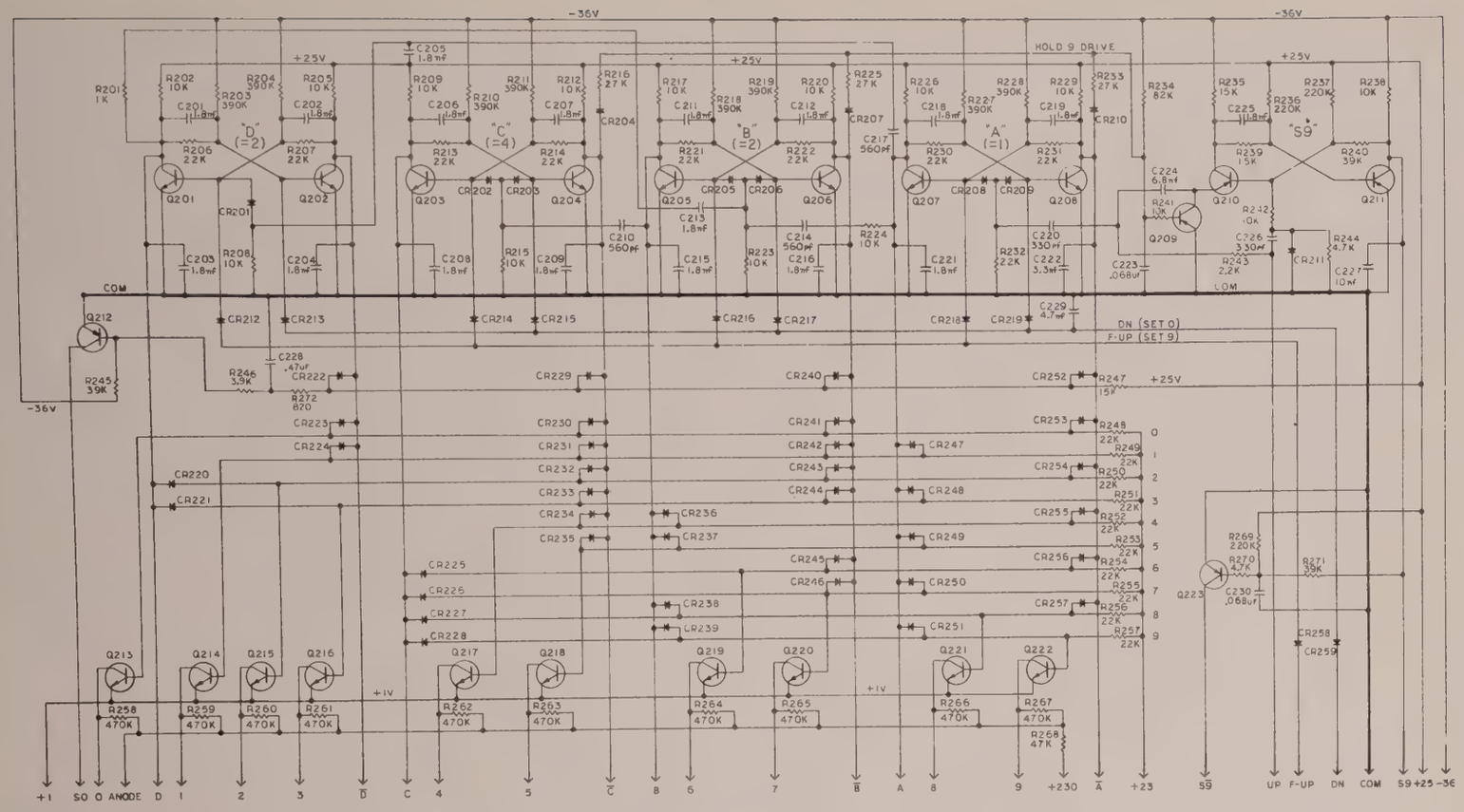


Figure 6-9. Units Through 1K Decade Assembly.



NOTES ◇

1. PLUG-IN PIN CONNECTIONS NOT SHOWN IN SAME ORDER AS ON ASSEMBLY.
2. UNLESS OTHERWISE NOTED, RESISTORS ARE ½ WATT & ±5% TOLERANCE.

Schematic Drawing 70-0702. Units Through 1K Decade Assembly.

Voltmeter Settings and Test Procedure

POWER switch:	ON FILTER OUT
SENSITIVITY control:	HI
FUNCTION switch:	DC
DC RANGE:	AUTO

1. Remove Logic Driver Assembly from slot 3 of the DVM. Insert Logic Test Assembly (Cimron part number 70-9504) into slot 3. DVM should be normal in all other respects.

2. Actuate DOWN logic test control until the first four decades indicate a count of 00000.

3. Actuate UP logic test control and the first four decades should indicate an accumulated count of 9999 in the following sequence.

   a. The least significant (units) decade should count sequentially from 0 to 9. The next UP pulse after the count of 9 will operate a shift 9 circuit in the units decade which will transfer UP pulses to the tens decade while holding the units decade at the count of 9. The operation of the shift 9 circuitry takes place on the tenth UP pulse so that the counting operation will appear to hesitate when the decade count has reached 9.

   b. The tens decade will count sequentially from 0 to 9, hesitate and transfer the count to the hundreds decade.

   c. The hundreds decade will count sequentially to 9 hesitate and transfer the count to the 1K decade.

   d. The 1K decade will count from 0 to 9, hesitate and transfer the count to the 10K decade.

4. With an indicated reading of 9999, actuate the DOWN test logic control. Observe that the four least significant decades sequentially and on successive pulses, set to 0 starting from the left.

5. Failure of the DVM to perform in the manner described in paragraphs 2, 3 and 4 above will indicate a faulty plug-in board where the instrument first refuses to follow logic commands. Replacement of the faulty board should permit the required logic sequence detailed above.

PARTS LIST

ASSEMBLY: Units Thru 1K Decade CIMRON PART NO. 70-6002

SCHEMATIC DESIGNATION	DESCRIPTION	CIMRON PART NO.
C201 - C209, C211, C212, C213, C215, C216, C218, C219, C221, C225	CAPACITOR, CER DISC, 0.0018 MF, 10%	1-57503
C210, C214, C217	CAPACITOR, CER DISC, 560 PF, 10%	1-57500
C220, C226	CAPACITOR, CER DISC, 330 PF, 10%	1-57507
C222	CAPACITOR, M MY, 0.0033 MF, 10%	1-57352
C223, C230	CAPACITOR, M PAP, 0.068 MF, 50V	1-57322
C224	CAPACITOR, M MY, 0.0068 MF, 10%	1-57354
C227	CAPACITOR, M PAP, 0.01 MF, 10%, 50V	1-57323
C228	CAPACITOR, 0.47 MF, 50V	1-57318
C229	CAPACITOR, 0.0047 MF, 10%	1-57353
R201	RESISTOR, 1K, 5%, 1/2W	7-41043
R202, R205, R208, R209, R212, R215, R217, R220, R223, R224, R226, R229, R238, R241, R242	RESISTOR, 10K, 5%, 1/2W	7-41055
R203, R204, R210, R211, R218, R219, R227, R228	RESISTOR, 390K, 5%, 1/2W	7-41074
R206, R207, R213, R214, R221, R222, R230, R231, R232, R248 - R257	RESISTOR, 22K, 5%, 1/2W	7-41059
R216, R225, R233	RESISTOR, 27K, 5%, 1/2W	7-41060
R234	RESISTOR, 82K, 5%, 1/2W	7-41066
R235, R239, R247	RESISTOR, 15K, 5%, 1/2W	7-41057
R236, R237, R269	RESISTOR, 220K, 5%, 1/2W	7-41071
R240, R245, R271	RESISTOR, 39K, 5%, 1/2W	7-41062
R243	RESISTOR, 2.2K, 5%, 1/2W	7-41047
R244, R270	RESISTOR, 4.7K, 5%, 1/2W	7-41051
R246	RESISTOR, 3.9K, 5%, 1/2W	7-41050
R258 - R267	RESISTOR, 470K, 5%, 1/2W	7-41075
R268	RESISTOR, 47K, 5%, 1/2W	7-41063
R272	RESISTOR, 820Ω, 5%, 1/2W	7-41042
CR201 - CR259	SEMICOND, DIODE, SILICON, CD-61	7-95511
Q201 - Q208	TRANSISTOR, CT-23	9-04706
Q209, Q212	TRANSISTOR, 2N1309	9-04611
Q210, Q211, Q223	TRANSISTOR, 2N404A	9-04609
Q213 - Q222	TRANSISTOR, CT-22	9-04705

10K DECADE

ASSEMBLY 70-6003

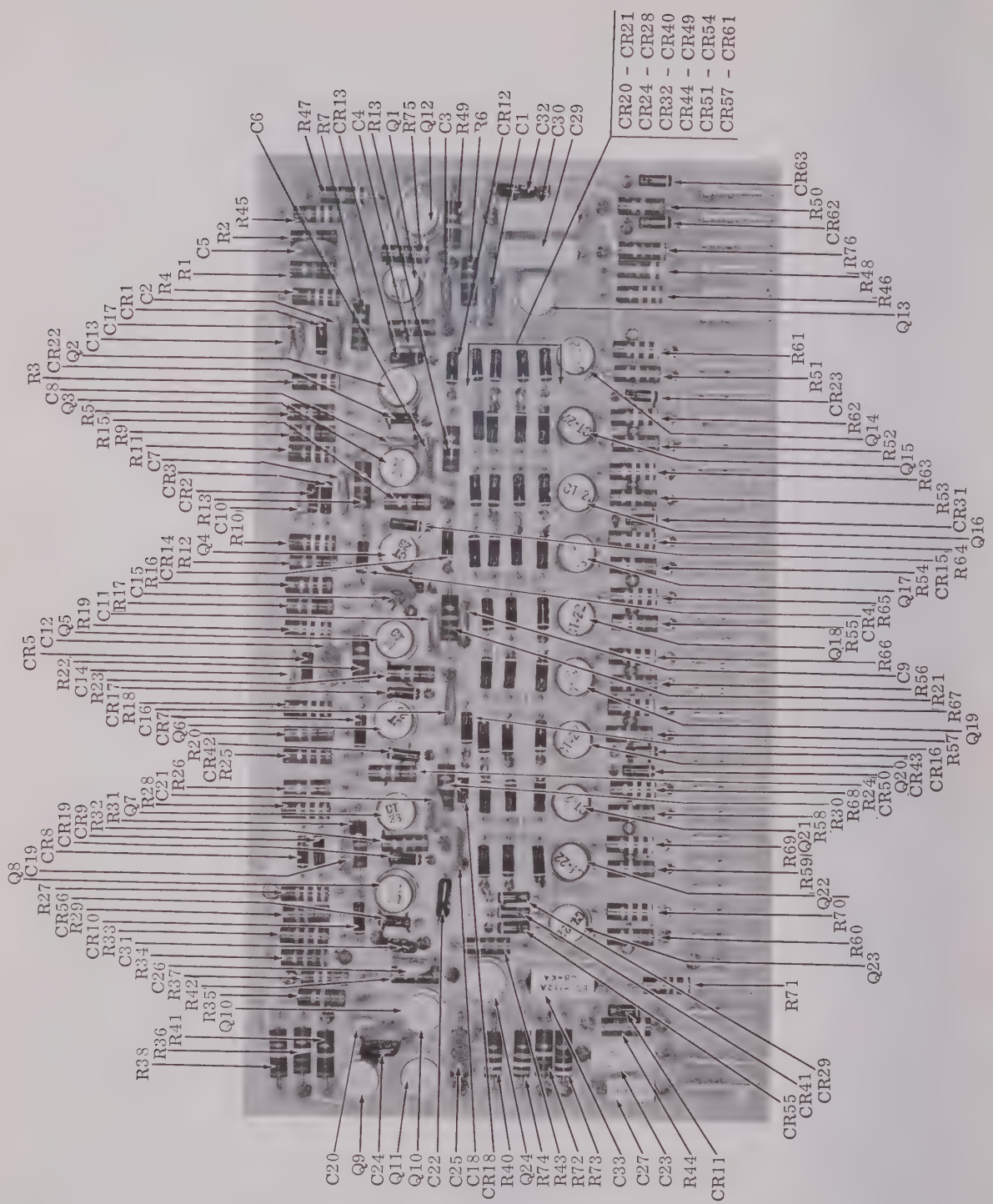
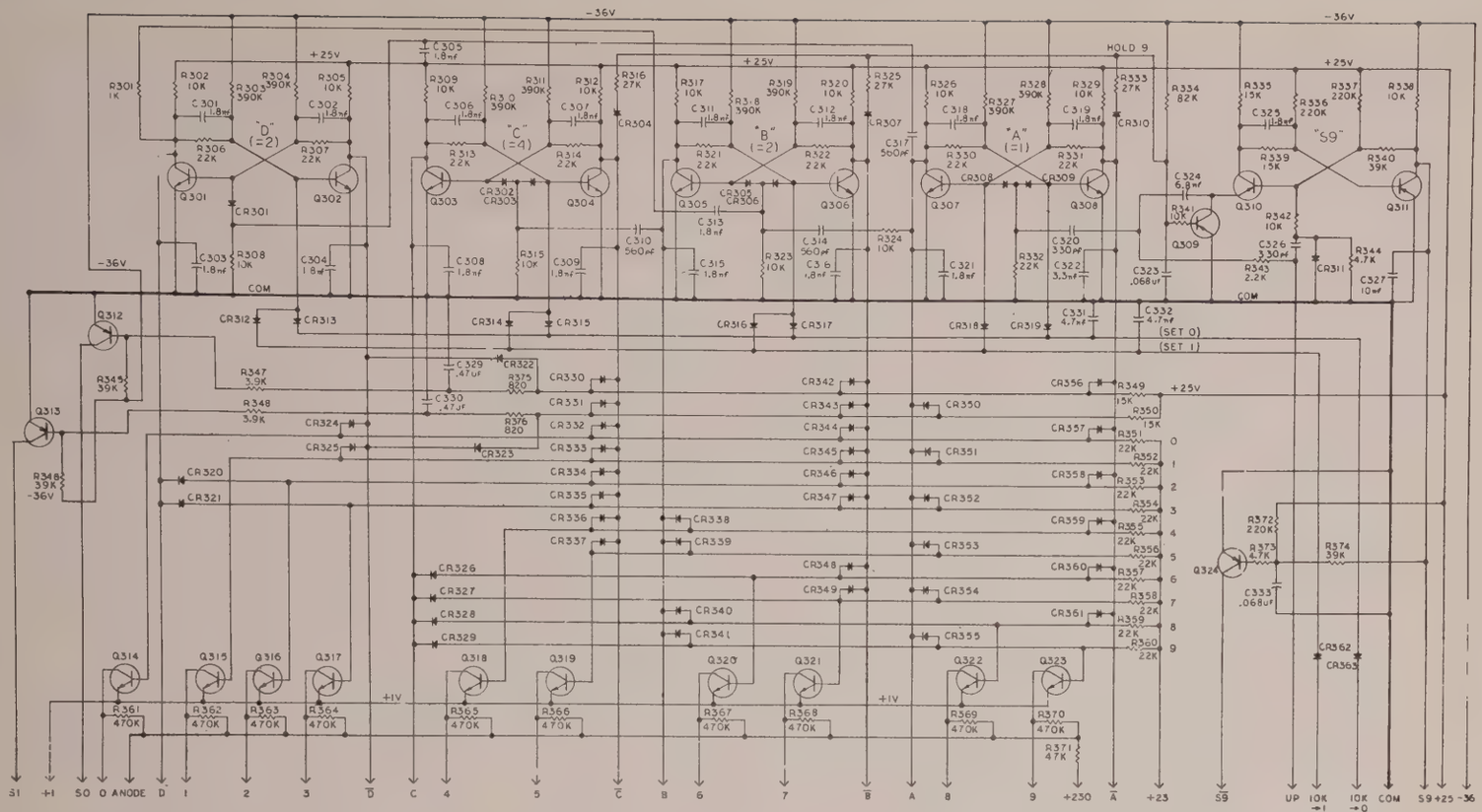


Figure 6-10. 10K Decade Assembly.



NOTES <>

1. PLUG-IN PIN CONNECTIONS NOT SHOWN IN SAME ORDER AS ON ASSEMBLY.
2. UNLESS OTHERWISE NOTED, RESISTORS ARE ½ WATT & ±5% TOLERANCE.

Schematic Drawing 70-0703, 10K Decade Assembly.

Voltmeter Settings and Test Procedure

POWER switch: ON FILTER OUT

SENSITIVITY control: HI

FUNCTION switch: DC

DC RANGE: AUTO

1. Remove Logic Driver Assembly from slot 3 of the DVM. Insert Logic Test Assembly (Cimron part number 70-9504) into slot 3. DVM should be normal in all other respects.

2. Actuate DOWN logic test control until decades indicate a count of 0.0000 either polarity.

3. Actuate the UP logic test control. Observe that the DVM counts to 999.99 in correct logic sequence. Observe that there is a one pulse delay while each decade assumes its shift 9 condition before the succeeding decade begins to count.

4. With an indicated readout of 999.99 actuate the DOWN logic test contro. Observe that the most significant digit sets a 1 count and the other decades in diminishing order set to 0 sequentially from the left. When a count of 100.00 is achieved, three more pulses will set the readout to 0.0000.

5. Failure of the DVM to sequentially perform in the manner described in paragraphs 2, 3 and 4 will indicate a faulty decade assembly at the assembly first refusing to follow logic commands. Replacement of the faulty assembly should permit the required logic sequencing described above.

RANGE AND POLARITY

ASSEMBLY 70-6007

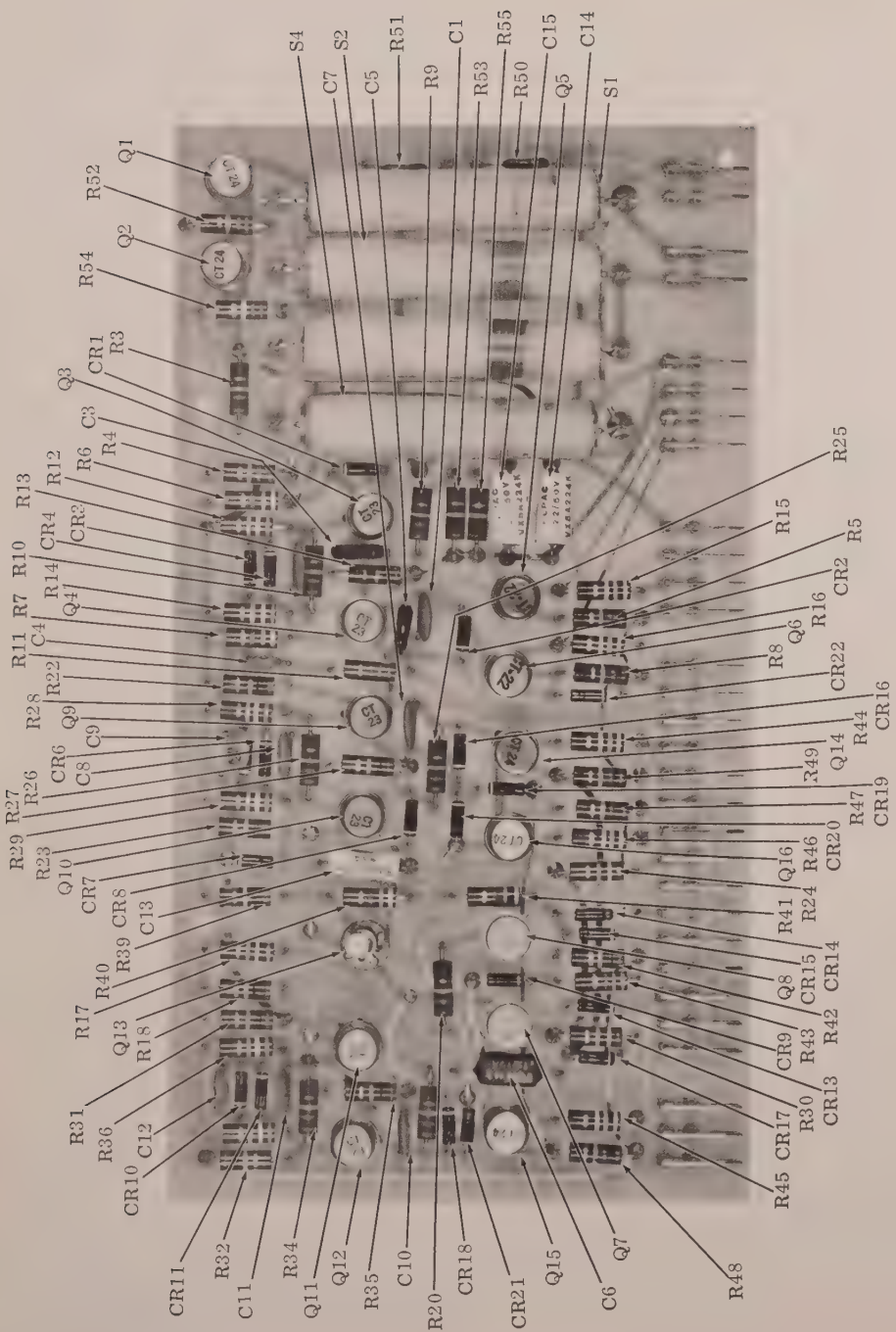
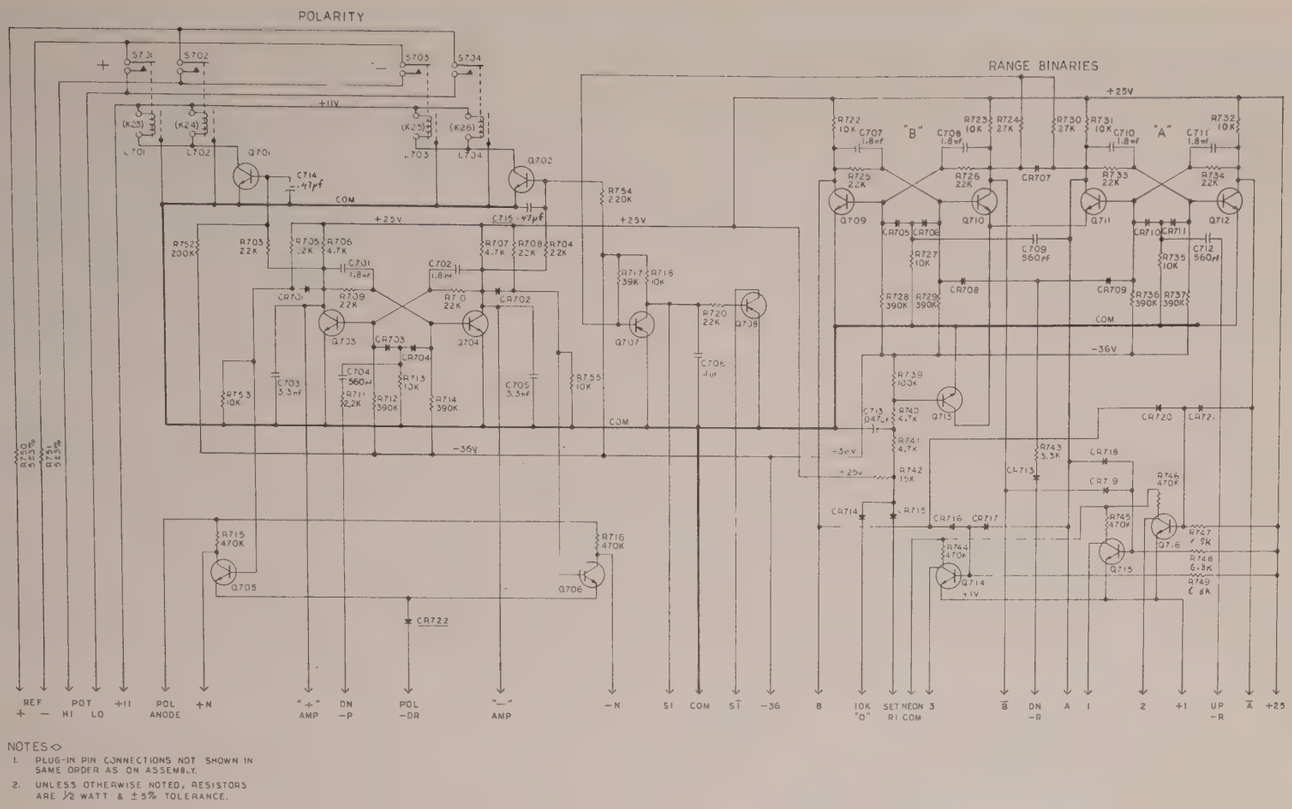


Figure 6-11. Range and Polarity Assembly.



Schematic Drawing 70-0707, Range and Polarity Assembly

Voltmeter Settings and Test Procedure

POWER switch:	ON FILTER OUT
SENSITIVITY control:	HI
FUNCTION switch:	DC
DC RANGE:	AUTO

1. Remove Logic Driver Assembly from slot 3 of the DVM. Insert Logic Test Assembly (Cimron part number 70-9504) into slot 3. DVM should be normal in all other respects.

2. Actuate DOWN logic test control until the decades indicate a count of 0.0000 in either polarity. Continuous application of DOWN pulses at this point should cause alternate polarity reversals with each pulse.

3. Actuate the UP logic test control. Observe that the DVM counts to 9.9999 in correct logic sequence. At this point two more UP pulses should cause a range UP shift to 999.99. Continued application of UP pulses should cause the range decimal indication to shift between the second and third most significant digits alternately. Set the FUNCTION switch to FILTER IN. Observe that this alternate ranging is appreciably slowed.

4. With the DVM readout indicating a count of 999.99, actuate the DOWN logic teat control and observe that the DVM counts sequentially to 100.00. Further application of 2 more DOWN pulses at this point will cause the instrument to down range to the basic range (1.0000).

5. Place the DC RANGE switch to the 10 RANGE. Actuate the UP logic test control. The DVM should sequentially count to 9.9999. Actuate the DOWN logic test control. The first down pulse should set the most significant decade to 0 with diminishing decades setting to 0 sequentially.

6. Failure of the DVM to perform logic and polarity operations described in paragraphs 2, 3, 4 and 5 will indicate a faulty Range and Polarity Assembly plug-in board. Replacement of the faulty board should permit required logic sequencing described above.

TECHNICIAN'S OUTLET

"A" POTENTIOMETER

ASSEMBLY 70-6012

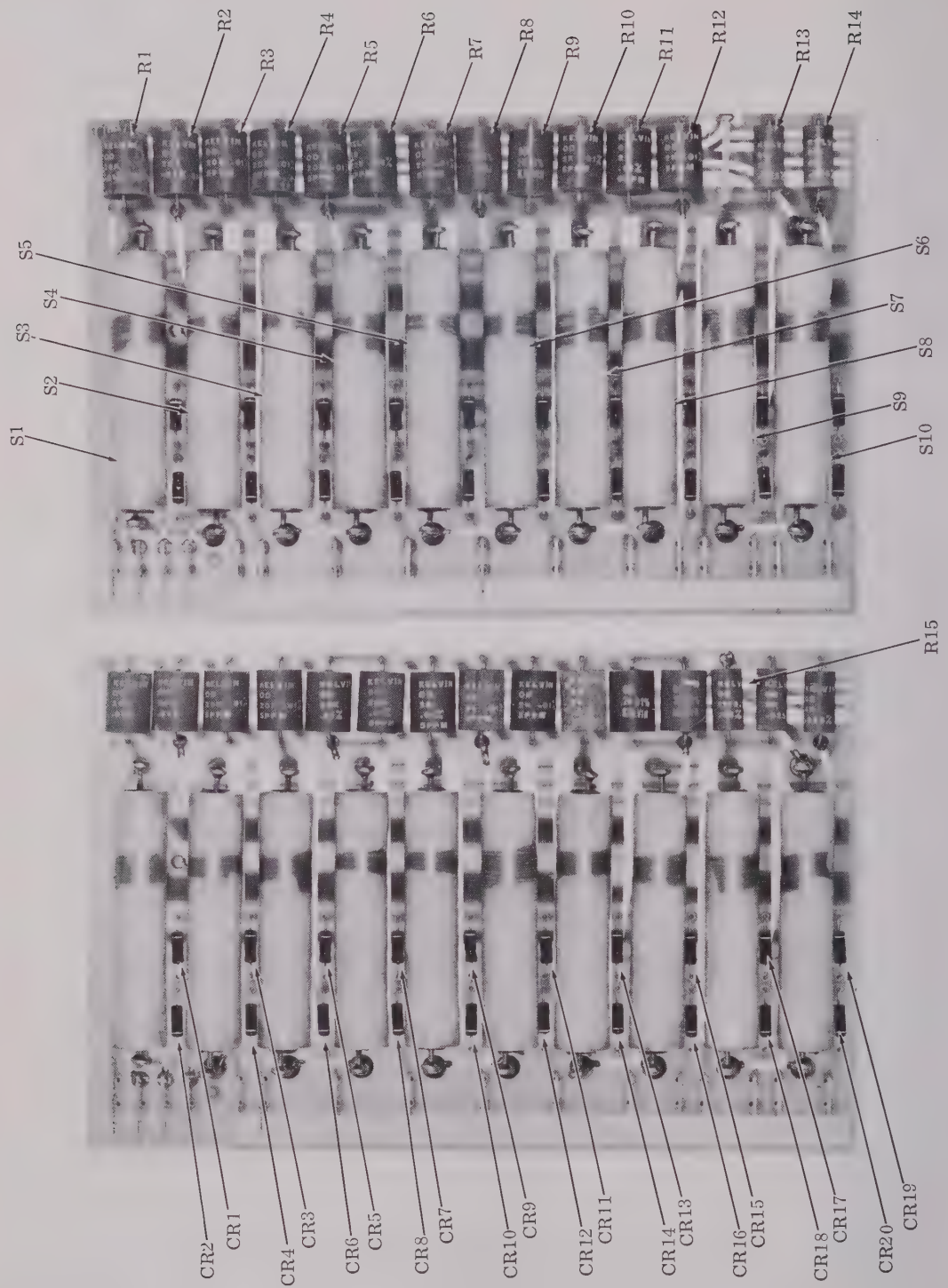
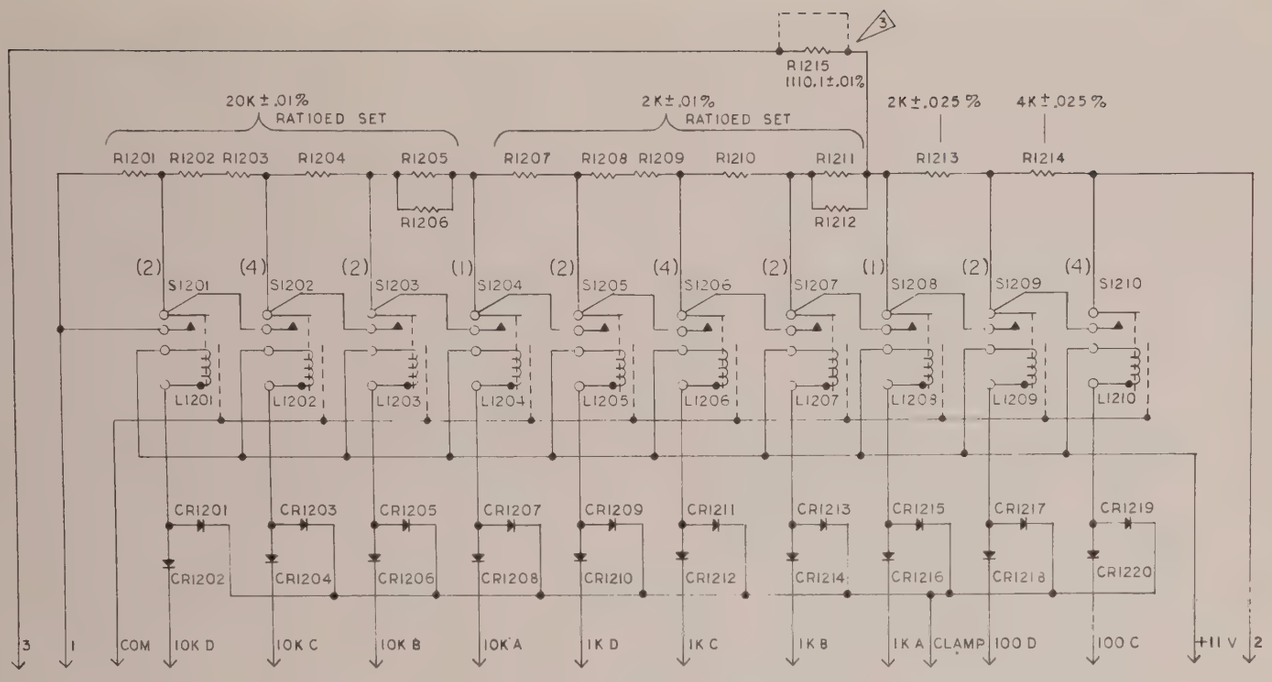


Figure 6-12. "A" Potentiometer Assembly.



Schematic Drawing 70-0702 "A" Potentiometer Assembly.

NOTES ◇

1. PLUG-IN PIN CONNECTIONS NOT SHOWN IN SAME ORDER AS ON ASSEMBLY.
2. THESE ASSEMBLIES ARE INSTALLED AS MATCHED PAIRS AND ARE NOT INDIVIDUALLY REPLACEABLE.
3. R1215 USED IN 70-6012-1 ASSY ONLY. IT IS REPLACED BY A JUMPER IN 70-6012-2 ASSY. ONE EACH -1 & -2 ASSY USED PER INSTRUMENT.

"A" Potentiometer Boards Test Procedure

Potentiometer Boards

POWER switch:	ON FILTER OUT
SENSITIVITY control:	HI
FUNCTION switch:	DC
DC RANGE:	10

Introduce to the input of the DVM calibrated voltages between 0 to 10 volts and note that voltmeter readout indicates correctly each voltage applied within the accuracy specification of the instrument. This constitutes a linearity test of the instrument. Gross non-linearities or erroneous readings indicate malfunction in the "A" Potentiometer Assemblies. Minor errors indicate malfunction of the "B" Potentiometer Assemblies.

WARNING

The two plug-in boards in the "A" Potentiometer Assembly are a matched pair and must be replaced as a set.

"B" POTENTIOMETER

ASSEMBLY 70-6013

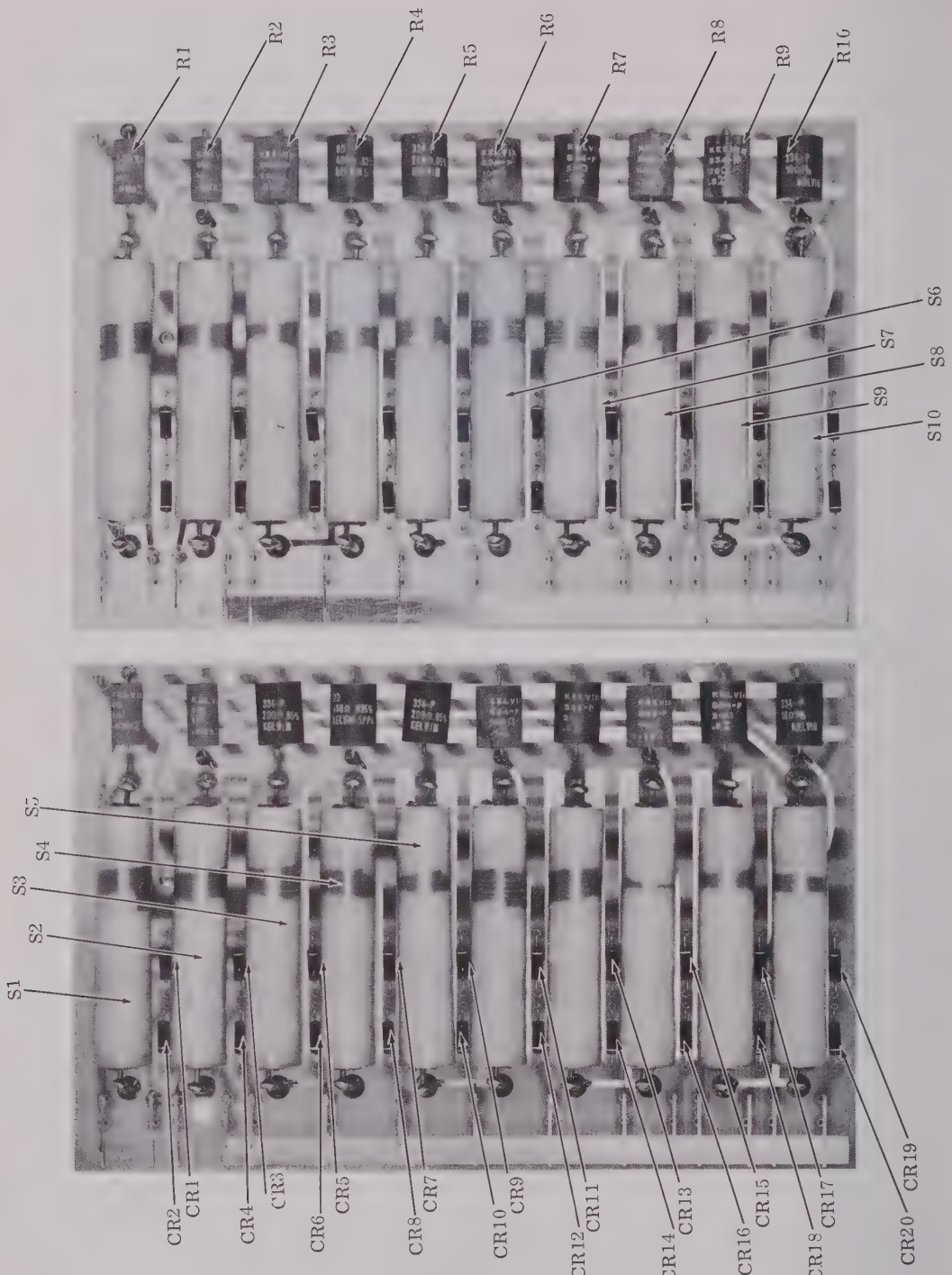
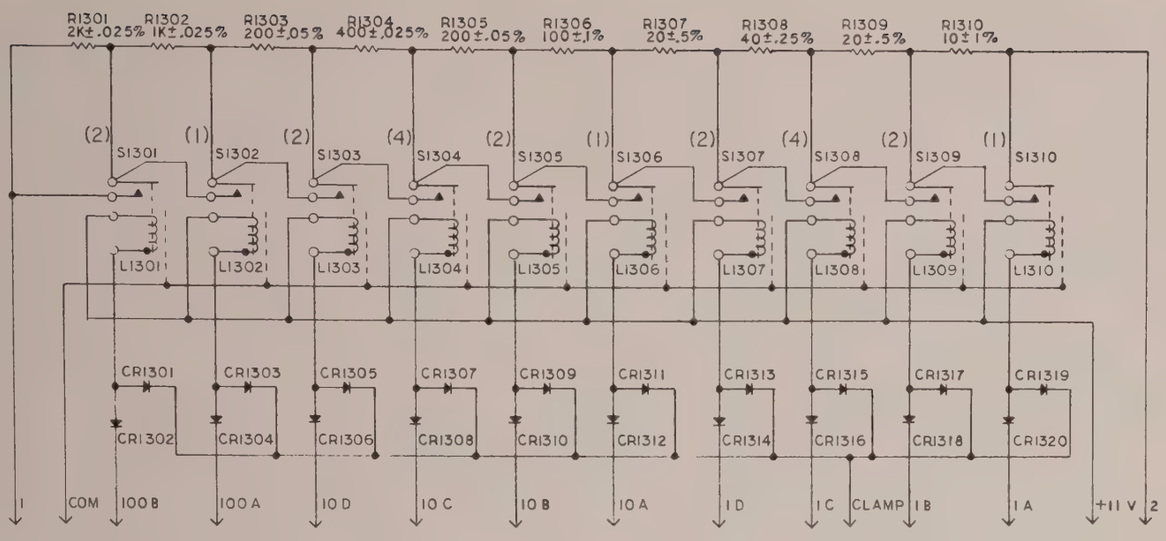


Figure 6-13. "B" Potentiometer Assembly.



NOTES ◇

1. PLUG-IN PIN CONNECTIONS NOT SHOWN IN SAME ORDER AS ON ASSEMBLY.

Schematic Drawing 70-0713 "B" Potentiometer Assembly.

"B" Potentiometer Boards Test Procedure

POWER switch.	ON FILTER OUT
SENSITIVITY control:	HI
FUNCTION switch:	DC
DC RANGE:	10

Introduce to the input of the DVM calibrated voltages between 0 to 10 volts and note that voltmeter readout indicates correctly each voltage applied within the accuracy specification of the instrument. This constitutes a linearity test of the instrument. Gross non-linearities or erroneous readings indicate malfunction in the "A" Potentiometer Assemblies. Minor errors indicate malfunction of the "B" Potentiometer Assemblies.

REMOTE FUNCTION

ASSEMBLY 70-6005-1 (MODELS 7300A AND 7500A)

AND

ASSEMBLY 70-6005-2 (MODELS 7200A AND 7400A)

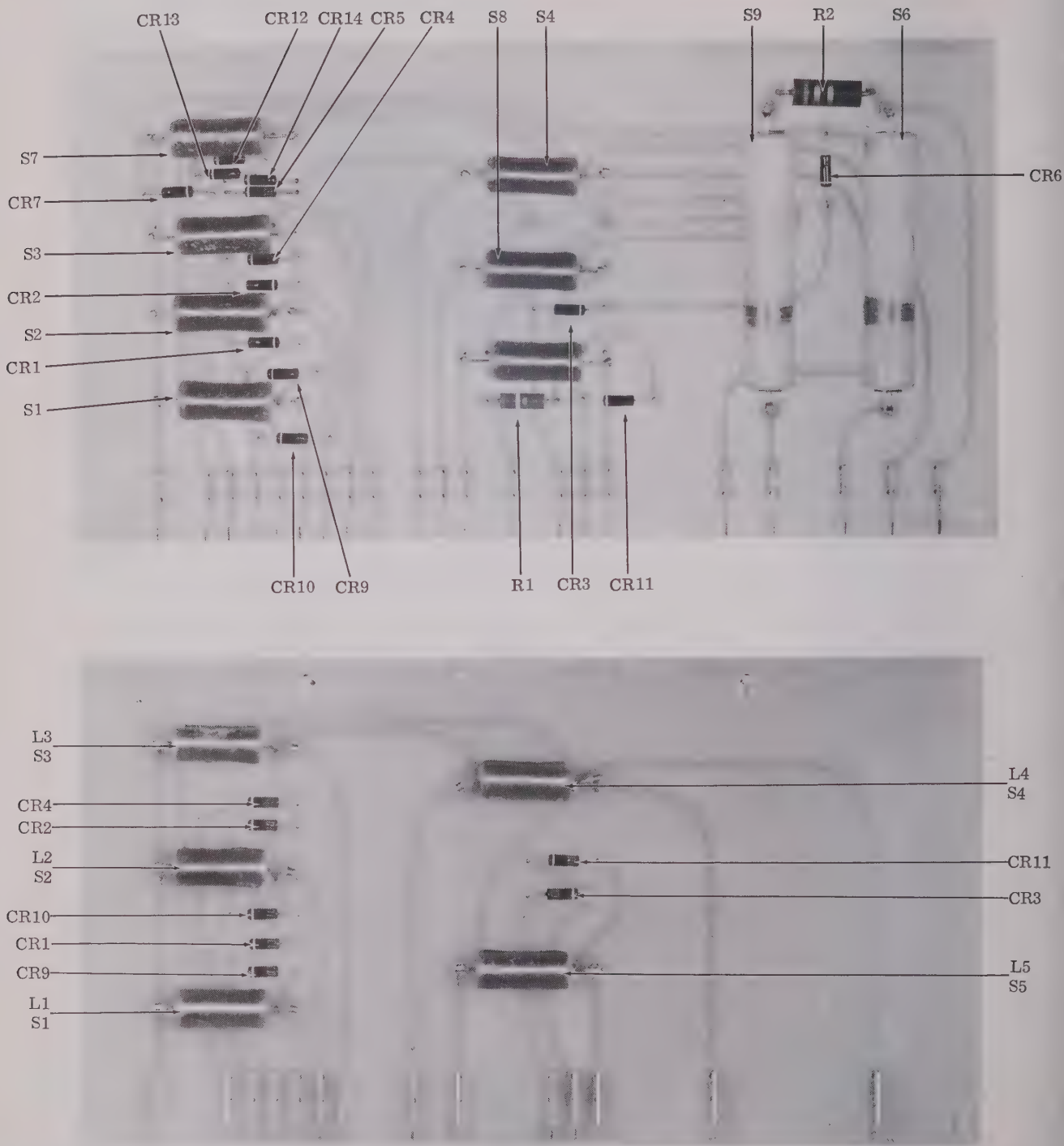
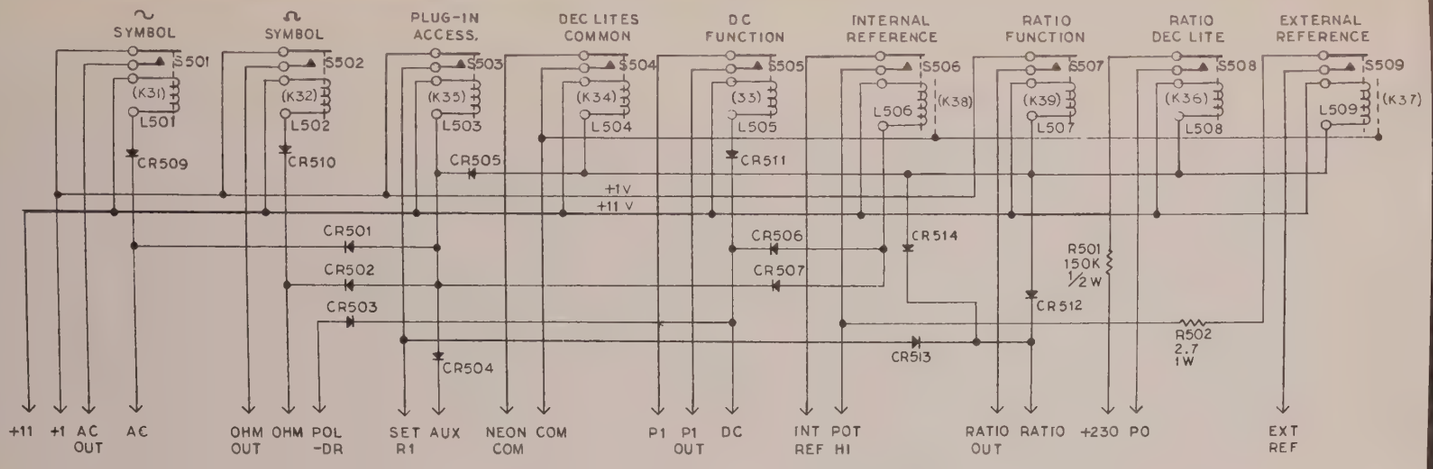
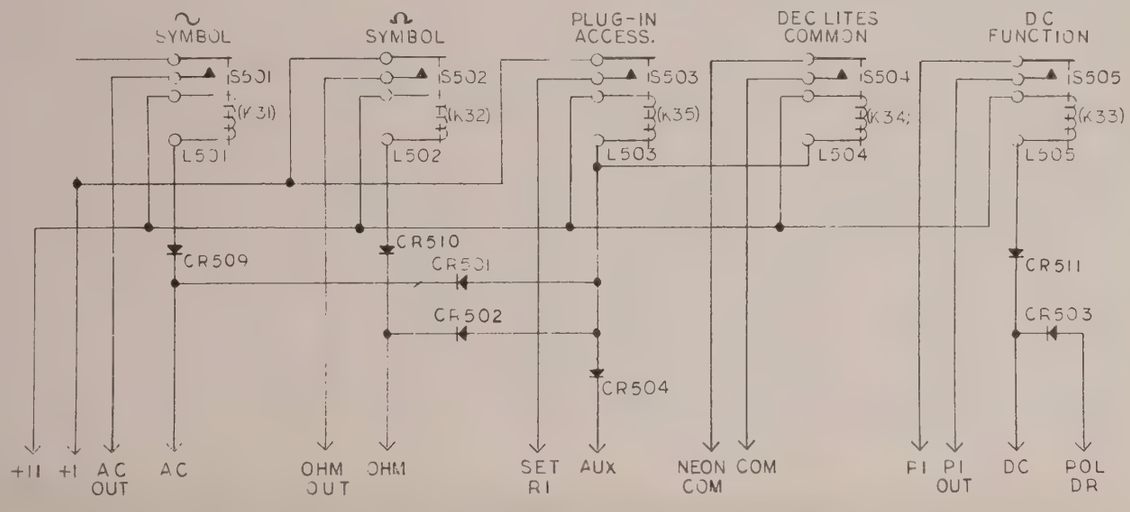


Figure 6-14. Remote Function Assembly.



Schematic Drawing 70-0710. Remote Function Assembly
Used With Models 7200A and 7400A.



Schematic Drawing 70-0705. Remote Function Assembly
Used With Models 7300A and 7500A.

Remote Function Assembly Test Procedure

The Remote Function Assembly controls decimal indicator power, polarity indicator power, internal or external reference selection and serves to lock instrument in basic range when any plug-in accessory FUNCTION is selected.

With FUNCTION switch in the DC position, the instrument will exhibit a polarity indication, an appropriate decimal and will provide connection of the internal reference to the high side of the precision potentiometer ("A" Potentiometer Assembly). AUTO ranging will be enabled when selected by the DC RANGE switch. On Models 7400A and 7500A with the FUNCTION switch in one of the two RATIO positions, there will be no polarity indication. The decimal will appear in the extreme left position (.00000). The external reference will be connected to the high side of the precision potentiometer. Internal reference will be disconnected and the instrument will be locked in range 1 (.99999 max).

With the FUNCTION switch in AC,OHMS or AUX position the polarity indicator will be controlled by the plug-in accessory and the decimal or range indication will also be controlled by the plug-in accessory. The internal reference will be connected to the high side of the potentiometer and the range binaries will not be allowed to change state.

With the FUNCTION switch set to the REMOTE position, the above named functions may be programmed by remote contact closure through the rear panel mounted remote input connector.

Failure of instrument to exhibit correct function switching indicates probable malfunction of this assembly.

PRINT CONTROL

(MODELS 7400A AND 7500A)

ASSEMBLY 70-6014

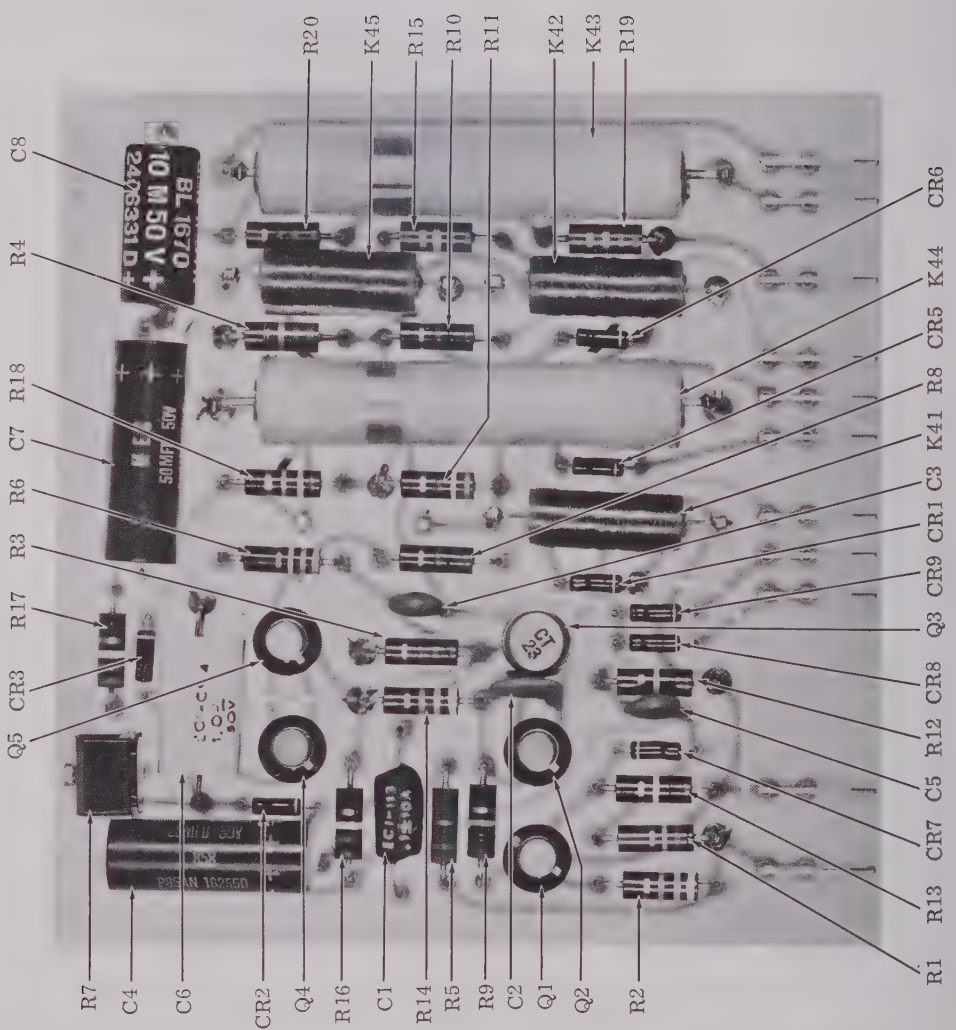
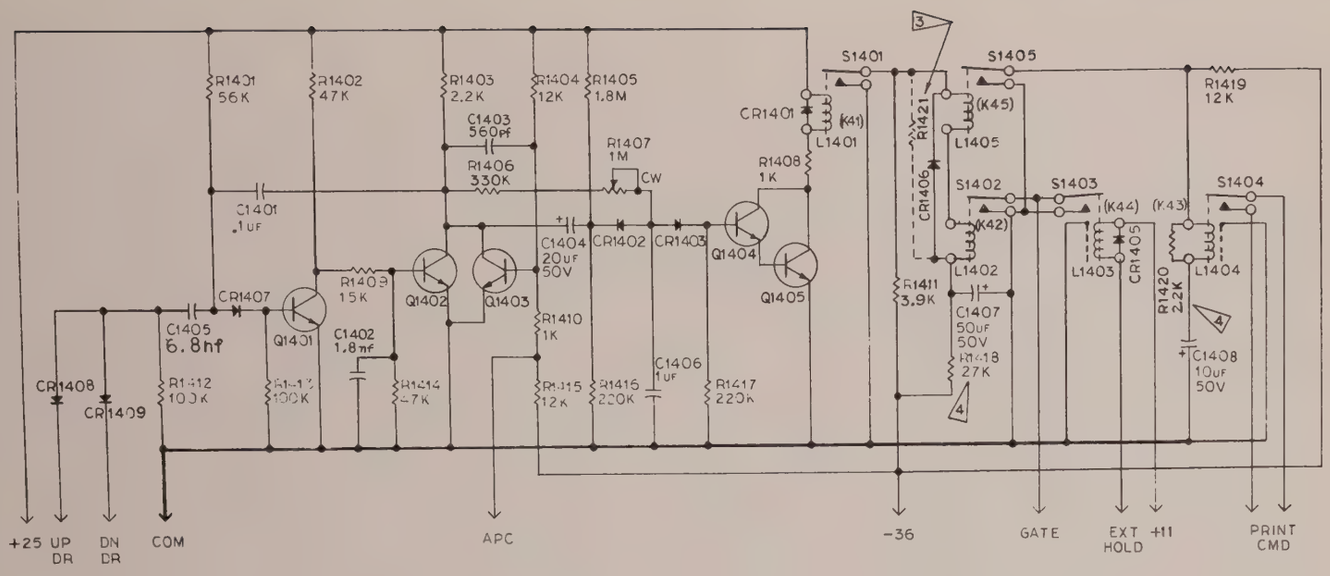


Figure 6-15. Print Control Assembly.



NOTES ◇

1. PLUG-IN PIN CONNECTIONS NOT SHOWN IN SAME ORDER AS ON ASSEMBLY.
2. UNLESS OTHERWISE NOTED, RESISTORS ARE 1/2 WATT & ±5% TOLERANCE.
3. R1421 (SELECTED VALUE) USED FOR SPECIAL APPLICATIONS ONLY.
4. VALUES OF R1418 & R1420 MAY BE DIFFERENT FOR SPECIAL APPLICATIONS.

Schematic Drawing 70-6014 Print Control Assembly
Used With Models 7400A and 7500A.

Print Control Assembly Test Procedure

POWER switch:	ON
SENSITIVITY control:	HI
FUNCTION switch:	DC
DC RANGE:	AUTO
PRINT CONTROL switch:	AUTO PRINT

Connect an ohmmeter between pins 40 and 48 of rear panel printer output connector J4. Connect an oscilloscope to GATE test point on the bottom of DVM to observe GATE pulse.

Introduce a voltage to the input of DVM sufficient to cause the instrument to count. Observe that when DVM reaches balance at input voltage there is a contact closure as indicated by the ohmmeter and GATE pulse is blanked as indicated by the oscilloscope. These should be simultaneous indications and should occur approximately 100 ms to 500 ms after DVM has reached null. This delay period is established by R1407 labeled PRINT DELAY. Place the PRINT COMMAND switch in the PRINT position and the ohmmeter indications listed above should be observed. (PRINT DELAY not effective in this mode).

Failure of DVM to blank GATE or issue PRINT COMMAND in steps listed above indicate malfunction of this assembly.

DOWN RANGE CONTROL

ASSEMBLY 70-6021

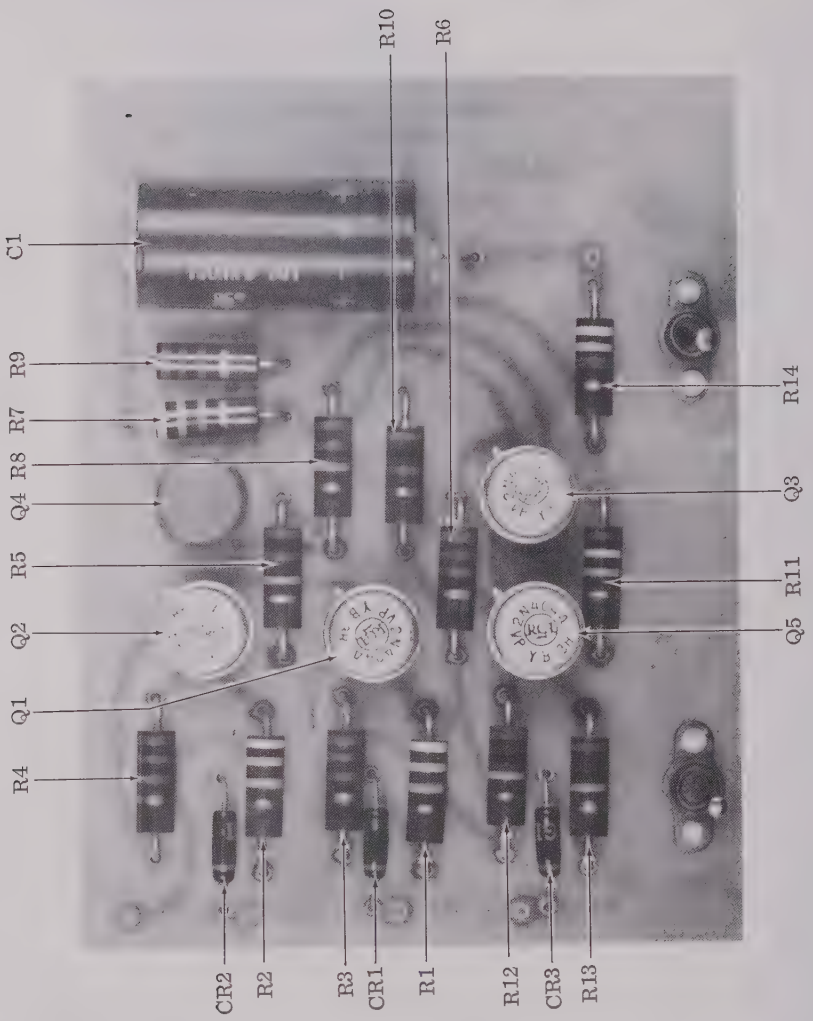
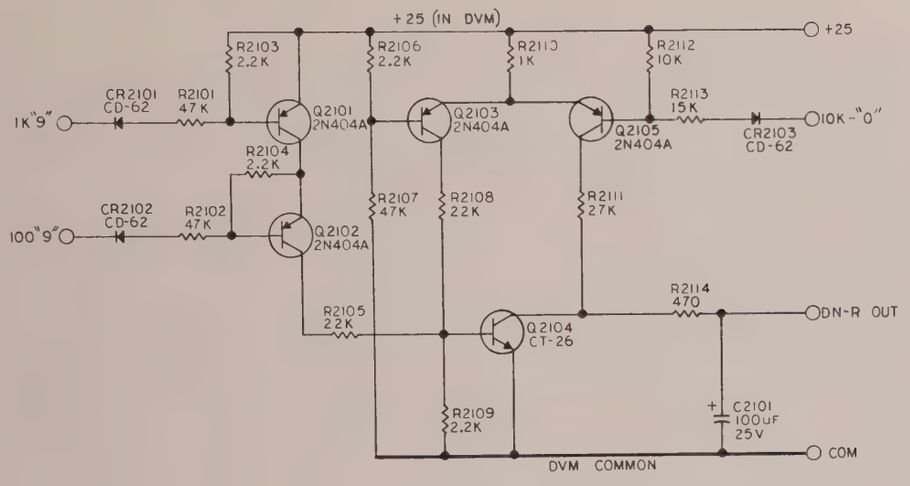


Figure 6-16. Down Range Control Assembly.



Schematic Drawing 70-0721. Down Range Control Assembly.

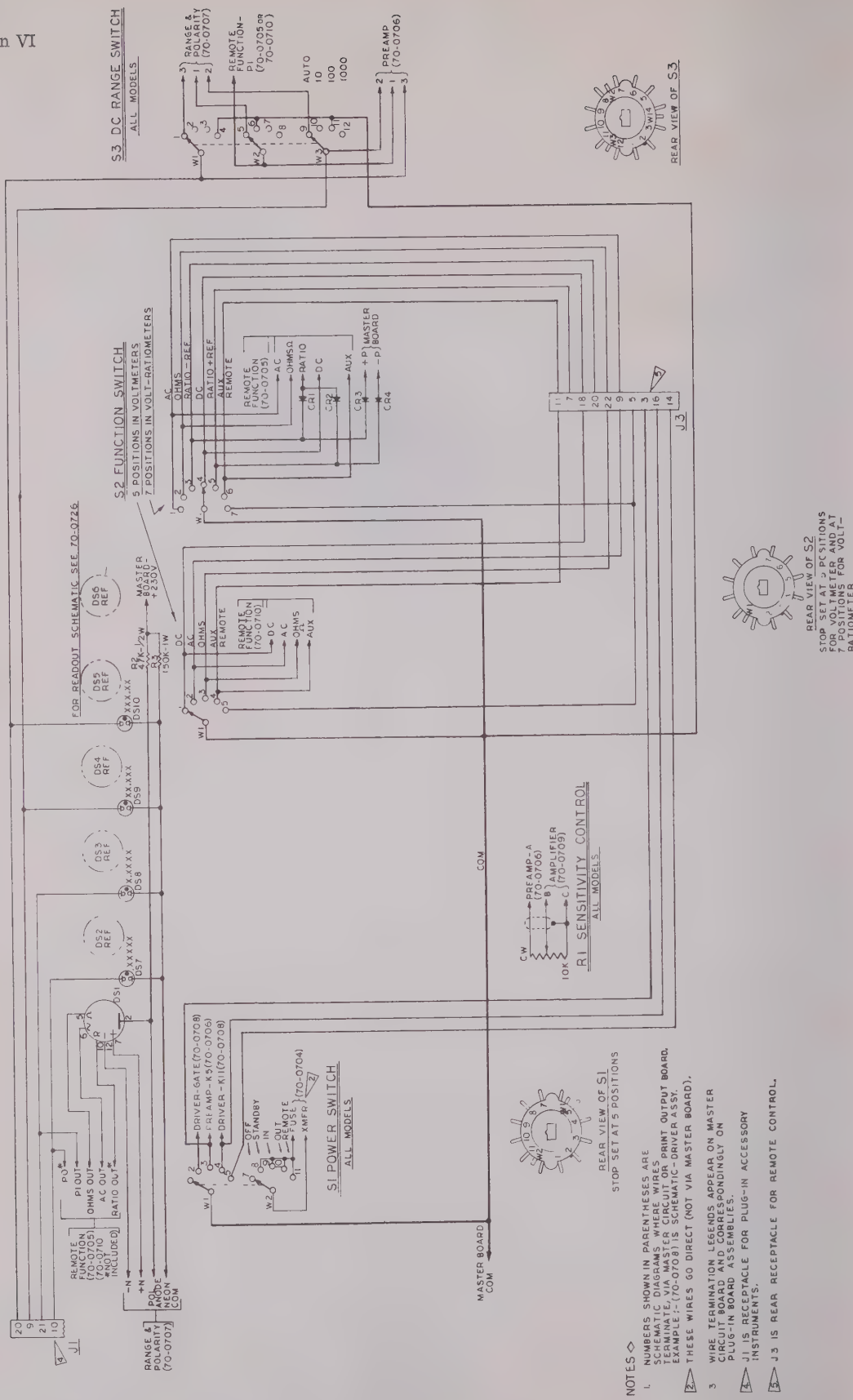
NOTES◇

1. UNLESS OTHERWISE NOTED RESISTORS ARE 1/2W & ±5% TOLERANCE.

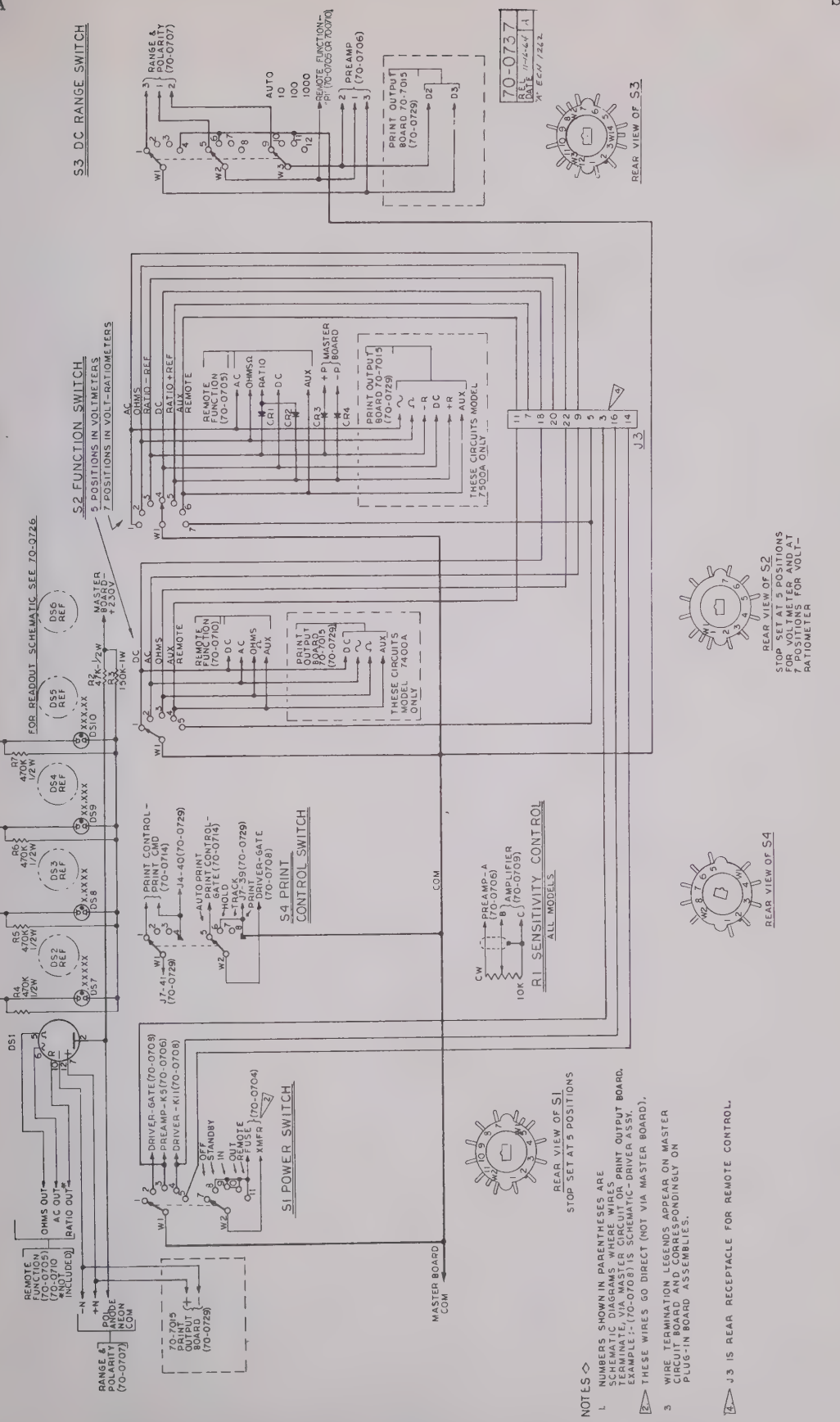
Voltmeter Settings and Test Procedure

POWER switch:	ON
SENSITIVITY control:	HI
FUNCTION switch:	DC
DC RANGE:	AUTO

Connect a DC voltmeter between pin 15 of the plug-in module mating connector and ground. Apply a voltage of 2 volts to the input of the DVM through a precision potentiometer. Observe that voltmeter indication is close to ground potential. Decrease input voltage to 1.0000 volts as indicated by the DVM. Note that DC voltmeter indication is still close to ground. Decrease input to 0.98 as indicated on the readout of the DVM. The voltmeter should indicate that the output of the Down Range Control Assembly rises to approximately 10 volts in less than two seconds. Any failure of the DVM to exhibit the above listed indications is due to a malfunction in this assembly.


S3 DC RANGE SWITCH
ALL MODELS
RANGE & POLARITY (70-0707)
REMOTE FUNCTION (70-0705 OR 70-0710)
AUTO
10
100
1000
PREAMP (70-0706)
REAR VIEW OF S3
S2 FUNCTION SWITCH
5 POSITIONS IN VOLTMETERS
7 POSITIONS IN VOLT-RATIOMETERS
FOR READOUT SCHEMATIC SEE 70-0726
MASTER BOARD +250V
R1 SENSITIVITY CONTROL
ALL MODELS
PREAMP-A (70-0706)
AMPLIFIER (70-0709)
S1 POWER SWITCH
ALL MODELS
OFF
STANDBY
IN
OUT
REMOTE
REAR VIEW OF S1
STOP SET AT 5 POSITIONS
REAR VIEW OF S2
STOP SET AT 5 POSITIONS FOR VOLTMETER AND AT 7 POSITIONS FOR VOLT-RATIOMETER
MASTER BOARD
COM
J1
J3
NOTES
1. NUMBERS SHOWN IN PARENTHESES ARE SCHEMATIC DIAGRAMS WHERE WIRES TERMINATE, VIA MASTER CIRCUIT OR PRINT OUTPUT BOARD. EXAMPLE:- (70-0708) IS SCHEMATIC-DRIVER ASSY.
2. THESE WIRES GO DIRECT (NOT VIA MASTER BOARD).
3. WIRE TERMINATION LEGENDS APPEAR ON MASTER CIRCUIT BOARD AND CORRESPONDINGLY ON PLUG-IN BOARD ASSEMBLIES.
4. J1 IS RECEPTACLE FOR PLUG-IN ACCESSORY INSTRUMENTS.
5. J3 IS REAR RECEPTACLE FOR REMOTE CONTROL.

Schematic 70-0736. Front Panel Controls, Models 7200A & 7300A.

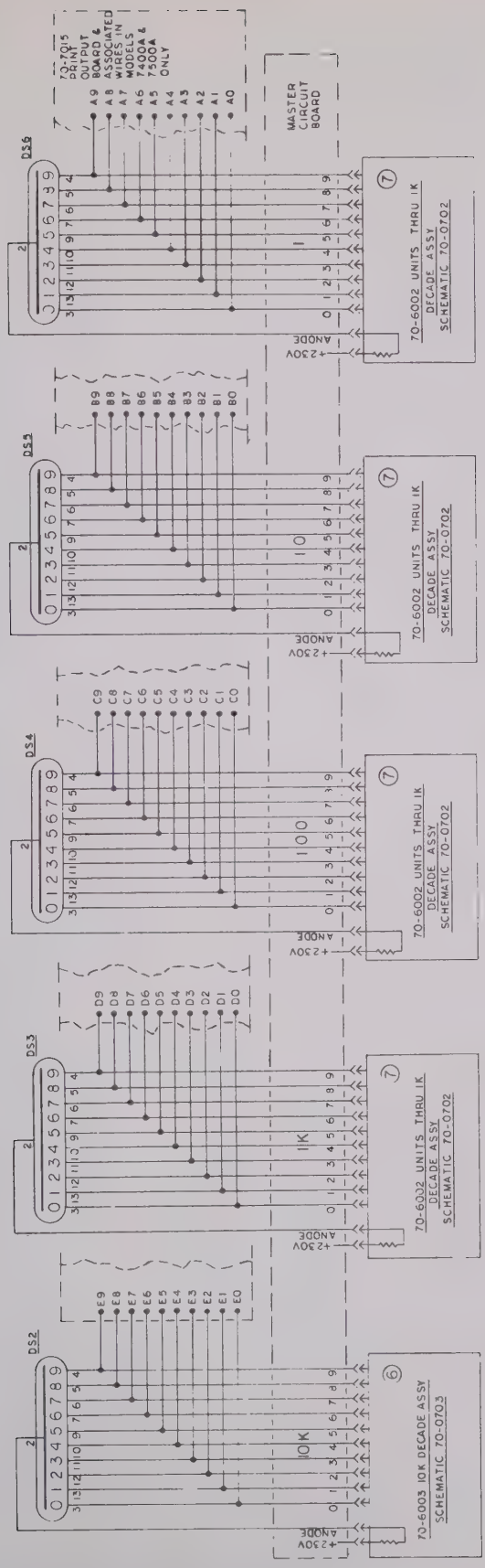


Schematic 70-0737. Front Panel Controls, Models 7400A & 7500A.

PARTS LIST

SUB ASSEMBLIES

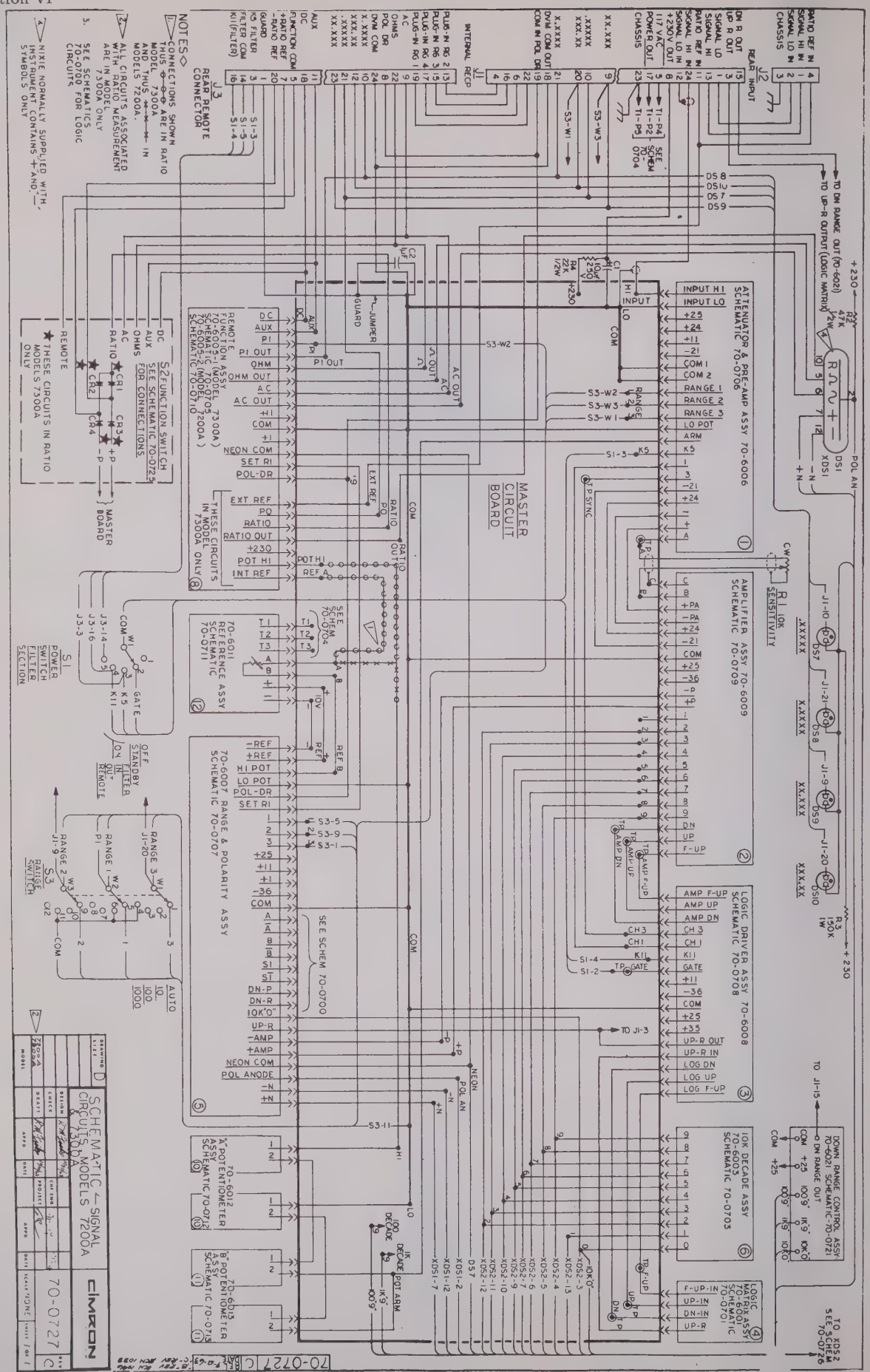
SCHEMATIC DESIGNATION	DESCRIPTION	CIMRON PART NO.
	FINAL ASSEMBLY	
F1	FUSE CARTRIDGE, 3 AG, SLO-BLO, 1/2 AMP	4-08013
	MAIN CHASSIS	
C2	CAPACITOR, M PAP, 1MF, 50V	1-57317
J1	CONNECTOR, RECEPT, ELECT, 24 PIN	2-50124
J2	CONNECTOR, RECEPT, ELECT, 4 PIN	2-52000
	READOUT & SWITCH SECTION	
R1	RESISTOR, VAR, COMP, 10K, 2W, CW LOG	60-0506-1
R2	RESISTOR, FIXED, 47K, 5%, 1/2W	7-41063
R3	RESISTOR, FIXED, 150K, 5%, 1@	7-44069
R4, R5, F6, R7	RESISTOR, 470K, 5%, 1/2W	7-41075
DS7, DS8, DS9, DS10	LIGHT-INDICATOR, NEON	5-63000
	POWER AND FILTER SWITCH	
S1	SWITCH ROTARY, 2 POL, 6 POS	9-64011
	RANGE SWITCH	
S3	SWITCH ROTARY, 3 POL, 4 POS	9-64012
	FUNCTION SWITCH	
S2	SWITCH ROTARY, 1 POL, 12 POS	8-64014
	FILTER CIRCUIT BOARD	
C1	CAPACITOR, ELECT, 10 MF, 25V	1-57216
R4	RESISTOR, FIXED, 22K, 5%, 1/2W	7-41059
	POWER TRANSISTORS	
Q1, Q2	TRANSISTOR, POWER, 2N1261	9-04610
	PRINT OUTPUT	
R1501	RESISTOR, FIXED, 75Ω, 3W	7-47150
R1502 - R1505	RESISTOR, 2.2KΩ, 5%, 1/4W	7-41047
L1501 - L1563	COIL, REED DRIVE	70-0502-1
S1501 - S1563	SWITCH, RELAY, MAGNETIC REED	7-38209
CR1501 - CR1566	SEMICOND DIODE, CD-62	7-95507
CR1567 - CR1630	SEMICOND DIODE, CD-61	7-95511
Q1501 - Q1504	TRANSISTOR, CT-25	9-04709
	INPUT CABLE	
	DIGITAL VOLTMETER, MODELS 7200A & 7400A	60-5007-1
	DIGITAL VOLT-RATIO METER, MODELS 7300A & 7500A	60-5007-3


DS6
DS5
DS4
DS3
DS2
70-7015 PRINT OUTPUT BOARD & ASSOCIATED WIRES IN MODELS 7400A & 7500A ONLY
MASTER CIRCUIT BOARD
A9 A8 A7 A6 A5 A4 A3 A2 A1 A0
B9 B8 B7 B6 B5 B4 B3 B2 B1 B0
C9 C8 C7 C6 C5 C4 C3 C2 C1 C0
D9 D8 D7 D6 D5 D4 D3 D2 D1 D0
E9 E8 E7 E6 E5 E4 E3 E2 E1 E0
10K
1K
100
10
1
+230V ANODE
70-6002 UNITS THRU 1K DECADE ASSY SCHEMATIC 70-0702
70-6003 10K DECADE ASSY SCHEMATIC 70-0703

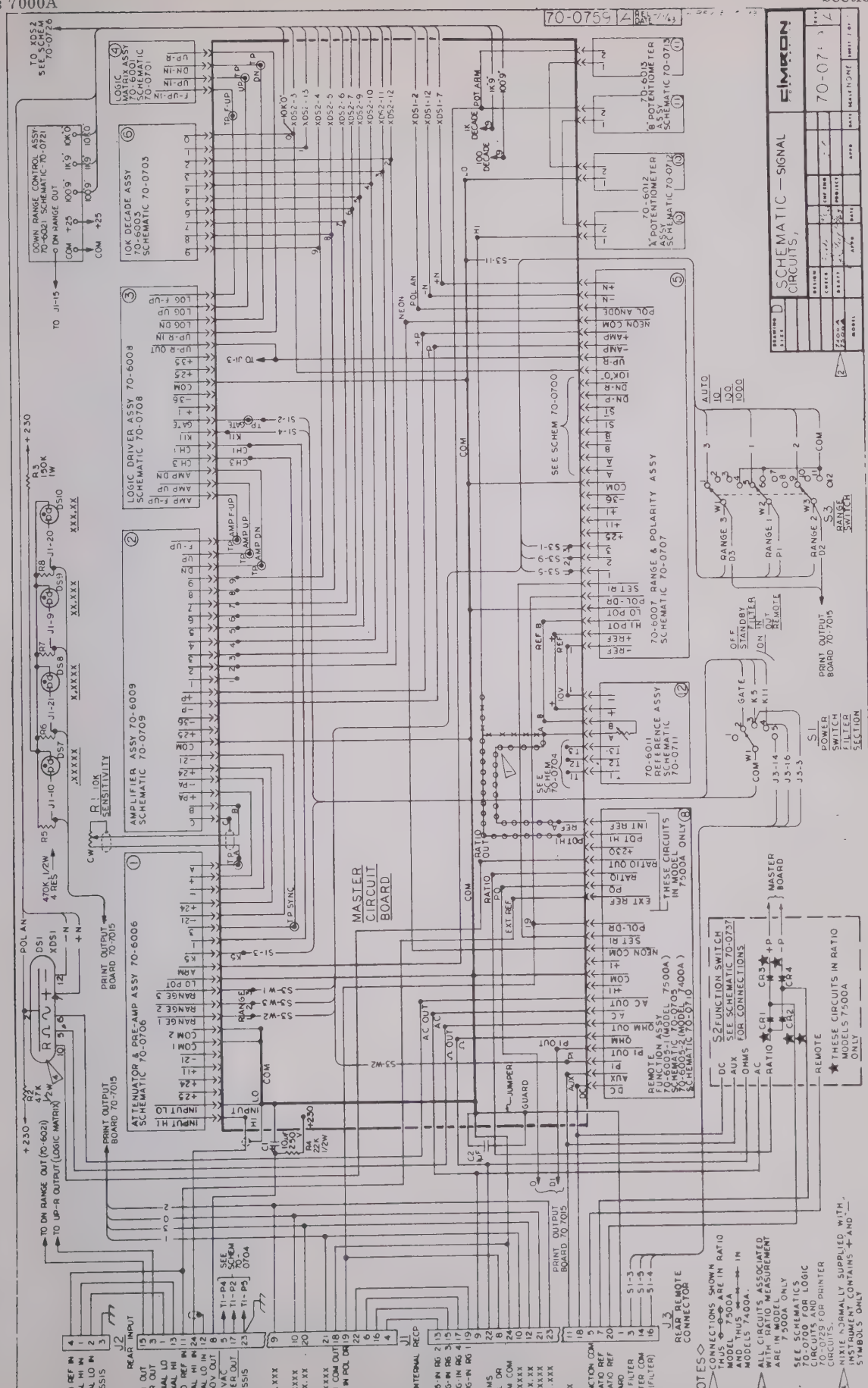
NOTES ◇

FOR CONNECTIONS TO POLARITY-(FUNCTION) NIXIE SEE SCHEMATIC 70-0725.

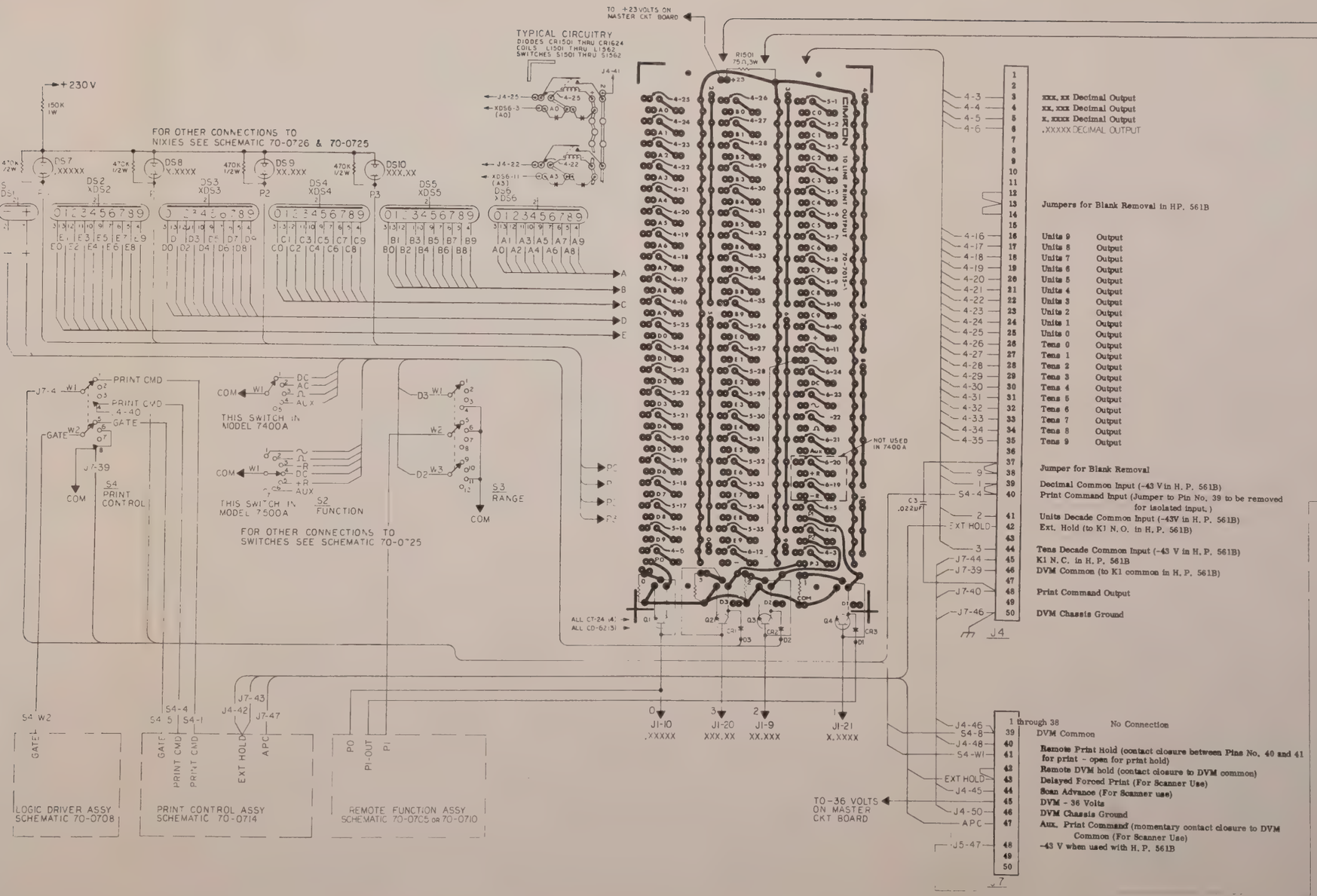
Schematic 70-0726, Numerical Neon Readout.



Schematic 70-0727. Signal Circuits, Models 7200A and 7300A.


70-0759 A
SCHEMATIC — SIGNAL CIRCUITS,
MASTER CIRCUIT BOARD
ATTENUATOR & PRE-AMP ASSY 70-6006 SCHEMATIC 70-0706
AMPLIFIER ASSY 70-6009 SCHEMATIC 70-0709
LOGIC DRIVER ASSY 70-6008 SCHEMATIC 70-0708
10K DECADE ASSY 70-6003 SCHEMATIC 70-0703
DOWN RANGE CONTROL ASSY 70-6021 SCHEMATIC 70-0721
LOGIC MATRIX ASSY 70-6001 SCHEMATIC 70-0701
70-6007 RANGE & POLARITY ASSY SCHEMATIC 70-0707
70-6011 REFERENCE ASSY SCHEMATIC 70-0711
70-6003 REMOTE FUNCTION ASSY SCHEMATIC 70-0703
S2 FUNCTION SWITCH SEE SCHEMATIC 70-0737 FOR CONNECTIONS
S1 POWER SWITCH FILTER SECTION
S3 RANGE SWITCH
70-6012 A POTENTIOMETER ASSY SCHEMATIC 70-0712
70-6013 B POTENTIOMETER ASSY SCHEMATIC 70-0713
J1 INTERNAL RECEP
J2 REAR INPUT
J3 REAR REMOTE CONNECTOR
PRINT OUTPUT BOARD 70-7015
SEE SCHEM 70-0700
SEE SCHEM 70-0704
THESE CIRCUITS IN MODEL 7500A ONLY
THESE CIRCUITS IN RATIO MODELS 7500A ONLY
MASTER BOARD
NOTES
1. CONNECTIONS SHOWN THUS ⊖⊖⊖ ARE IN RATIO MODEL 7500A AND THUS ⊖⊖⊖ IN MODELS 7400A.
2. ALL CIRCUITS ASSOCIATED WITH RATIO MEASUREMENT ARE 7500A ONLY
3. SEE SCHEMATICS 70-0700 FOR LOGIC CIRCUITS AND 70-0729 FOR PRINTER CIRCUITS.
4. ★ NORMALLY SUPPLIED WITH INSTRUMENT CONTAINS + AND − SYMBOLS ONLY

Schematic 70-0759. Signal Circuits, Models 7400A and 7500A.



4-3	3	xxx. xx Decimal Output
4-4	4	xx. xxx Decimal Output
4-5	5	x. xxxx Decimal Output
4-6	6	.XXXXX DECIMAL OUTPUT
	7	
	8	
	9	
	10	
	11	
	12	
	13	Jumpers for Blank Removal in H.P. 561B
	14	
4-16	16	Units 9 Output
4-17	17	Units 8 Output
4-18	18	Units 7 Output
4-19	19	Units 6 Output
4-20	20	Units 5 Output
4-21	21	Units 4 Output
4-22	22	Units 3 Output
4-23	23	Units 2 Output
4-24	24	Units 1 Output
4-25	25	Units 0 Output
4-26	26	Tens 0 Output
4-27	27	Tens 1 Output
4-28	28	Tens 2 Output
4-29	29	Tens 3 Output
4-30	30	Tens 4 Output
4-31	31	Tens 5 Output
4-32	32	Tens 6 Output
4-33	33	Tens 7 Output
4-34	34	Tens 8 Output
4-35	35	Tens 9 Output
	36	
	37	Jumper for Blank Removal
9	38	Decimal Common Input (-43 V in H. P. 561B)
S4-4	39	Print Command Input (Jumper to Pin No. 39 to be removed for isolated input.)
2	41	Units Decade Common Input (-43V in H. P. 561B)
EXT HOLD	42	Ext. Hold (to K1 N.O. in H. P. 561B)
3	44	Tens Decade Common Input (-43 V in H. P. 561B)
J7-44	45	K1 N.C. in H. P. 561B
J7-39	46	DVM Common (to K1 common in H. P. 561B)
J7-40	48	Print Command Output
J7-46	50	DVM Chassis Ground

J4

J4-46	1 through 38	No Connection
S4-8	39	DVM Common
J4-48	40	Remote Print Hold (contact closure between Pins No. 40 and 41 for print - open for print hold)
S4-W1	41	Remote DVM hold (contact closure to DVM common)
EXT HOLD	43	Delayed Forced Print (For Scanner Use)
J4-45	44	Scan Advance (For Scanner use)
J4-50	46	DVM - 36 Volts
APC	47	DVM Chassis Ground
J5-47	48	Aux. Print Command (momentary contact closure to DVM Common (For Scanner Use)
	49	-43 V when used with H. P. 561B
	50	

J7

5-1	1	Hundreds 0 Output
5-2	2	Hundreds 1 "
5-3	3	Hundreds 2 "
5-4	4	Hundreds 3 "
5-5	5	Hundreds 4 "
5-6	6	Hundreds 5 "
5-7	7	Hundreds 6 "
5-8	8	Hundreds 7 "
5-9	9	Hundreds 8 "
5-10	10	Hundreds 9 "
	11	
	12	
	13	Jumpers for Blank Removal in H. P. 561B
	14	
5-16	16	Thousands 9 Output
5-17	17	Thousands 8 "
5-18	18	Thousands 7 "
5-19	19	Thousands 6 "
5-20	20	Thousands 5 "
5-21	21	Thousands 4 "
5-22	22	Thousands 3 "
5-23	23	Thousands 2 "
5-24	24	Thousands 1 "
5-25	25	Thousands 0 "
5-26	26	Ten Thousands 0 Output
5-27	27	Ten Thousands 1 "
5-28	28	Ten Thousands 2 "
5-29	29	Ten Thousands 3 "
5-30	30	Ten Thousands 4 "
5-31	31	Ten Thousands 5 "
5-32	32	Ten Thousands 6 Output
5-33	33	Ten Thousands 7 "
5-34	34	Ten Thousands 8 "
5-35	35	Ten Thousands 9 "
	36	
	37	Jumper for Blank Removal in H. P. 561B
	38	
	39 through 46	No Connection
	47	Isolated Input to Scanner with Jumper to Pin No. 48 removed
	48	Hundreds Decade Common Input (-43 V in H. P. 561B)
	49	Thousands Decade Common Input (-43 V in H. P. 561B)
	50	Ten Thousands Decade Common Input (-43 V in H. P. 561B)

J5

	1 through 10	No Connection
6-11	11	(-) Polarity Output
6-12	12	Blank Removal for (-) Polarity (No outputs for + Polarity)
	13	
	14	Jumper for Blank Removal in H. P. 561B
	15 through 18	No Connection
6-19	19	Ratio - Ref Output (on ratio instruments only)
6-20	20	Ratio + Ref Output (on ratio instruments only)
6-21	21	Aux. Output
6-22	22	Ohms Output
6-23	23	A. C. Output
6-24	24	D. C. Output
	25 through 38	No Connection
7	39	Polarity Common Input (-43 V in H. P. 561B)
6-40	40	+ Polarity Output (Not used in H. P. 561B)
8	41	Function Common Input (-43 V in H. P. 561B)
	42 through 50	No Connection

J6

Schematic 70-0729. Printer Circuitry.

SECTION VII

RECOMMENDED SPARE PARTS

The following is a list of the recommended spare parts required to maintain a specific number of instruments at a satisfactory level of performance for one year in an isolated area.

Table 7-1. Recommended Spare Parts.

ASSEMBLY OR PART NAME	ASSEMBLY OR PART NUMBER	QUANTITY OF PARTS		
		1 Instrument	5 Instruments	10 Instruments
Attenuator and Preamplifier	70-6006	1	3	5
Amplifier	70-6009	1	3	5
Logic Driver	70-6008	1	3	5
Logic Matrix	70-6001	1	3	5
Range and Polarity	70-6007	1	3	5
10K Decade	70-6003	1	3	5
Units Through 1K Decade	70-6002	2	6	10
Remote Function, Models 7300A and 7500A	70-6005-1	1	3	5
Remote Function, Models 7200A and 7400A	70-6005-2	1	3	5
Power Supply	70-6004	1	3	5
"A" Potentiometer Set	70-6012	1	3	5
"B" Potentiometer	70-6013	1	3	5
Reference Supply	70-6011	1	3	5
Print Output, Models 7400A and 7500A only	70-6014	1	3	5
Numeral Neon Indicator	3-41403	2	6	10
Polarity Neon Indicator	3-41402	1	3	5
Converter (chopper)	70-0505-1	1	3	5
Board Puller	60-3015-1	1	3	5
Fuse 3AG S-B 1/2A	4-08013	5	5	10
Fuse Holder	4-12000	1	3	5
Knob Skirted	5-42003	1	3	5
Input Cable Assembly	60-5007-7	1	2	3
Polarizer Readout	60-3010-5	1	2	2

NOTE

The extension boards recommended below are not a functional part of the instrument. They are designed primarily as an aid in troubleshooting. The extension board is placed between a suspected plug-in board and its mating connector in the instrument. The suspected board is thus raised above the surface of the instrument permitting easy access to components and test points.

Table 7-2. Test and Extension Board Assemblies.

ASSEMBLY OR PART NAME	ASSEMBLY OR PART NUMBER	QUANTITY OF PARTS		
		1 Instrument	5 Instruments	10 Instruments
Extension Board (Standard)	70-9501-1	1	2	4
Extension Board (Potentiometer)	70-9502-3	1	2	4
Extension Board (Reference)	70-9503-1	1	2	4
Logic Board Tester	70-9404	1	1	1

SECTION VIII

ACCESSORIES

TABLE OF CONTENTS

Paragraph	Page
PLUG-IN CAPABILITIES	8-1
AC-DC CONVERTER	8-2
DC PRE-AMPLIFIER	8-3
OHMS-DC CONVERTER	8-4
DC STABLE SOURCE	8-5
HIGH VOLTAGE MODULE	8-6
SPECIAL PLUG-IN MODULES	8-6

PLUG-IN CAPABILITIES

CIMRON's concept of front panel plug-in modules is simpler and far less costly to keep up with changing instrumentation needs. The basic unit of the Series 7000A is a 5-digit, DC Volt or Volt-Ratio Meter which will accept input modules for measuring AC, ohms, microvolts, high voltage to 7.5 KV and to become a precision DC voltage standard. These modules require no external power or modifications of any kind.

Figure 8-1. Plug-in Capability.

AC-DC CONVERTER Models 6700A, 6701A and 6710A

These all solid state AC-DC Converters incorporate latest design techniques and components to provide exceptional performance. Stability and accuracy are particularly outstanding due to the use of silicon transistors with a field effect input transistor. Conversion is accomplished by a full wave averaging circuit with the output calibrated in rms.

Range: 6700A: 0.0000 to 99.999V AC in three manually-selected ranges of 9.9999, 99.999 and 999.99V AC.
6701A: .00000 to 999.99V AC in four manually-selected ranges of .99999, 9.9999, 99.999 and 999.99V AC.
6710A: 0.0000 to 999.99V AC in three manually, automatically or remotely selected ranges of 9.9999, 99.999 and 999.99V AC.

Combined Accuracy: 6700A and 6701A: Within 0.05% of reading or ±0.01% of full scale from 50 cps to 5K cps, 0.01% of reading or ±0.02% of full scale from 30 cps to 10K cps, including all effects of linearity, input attenuation and frequency.
6710A: Within 0.01% of reading or ±0.03% of full scale including all effects of linearity, frequency and input attenuation over a bandwidth from 30 cps to 10K cps.

Stability: Typically better than 0.03% of full scale for 90 days under normal laboratory conditions.

Linearity: 6700A and 6701A: Within 0.01% of full scale from 50 cps to 5K cps, and within 0.01% of full scale from 30 cps to 10K cps.
6710A: 0.03% of full scale from 30 cps to 10K cps.

Input Impedance: 6700A: 10 megohms shunted by less than 50 pf.
6701A: 1 megohm shunted by 50 pf for .00000 to .99999V AC range, 10 megohms shunted by 50 pf for all other ranges.
6710A: 10 megohms shunted by less than 50 pf.

Weight: 5 lbs. net, 7 1/2 lbs. shipping.

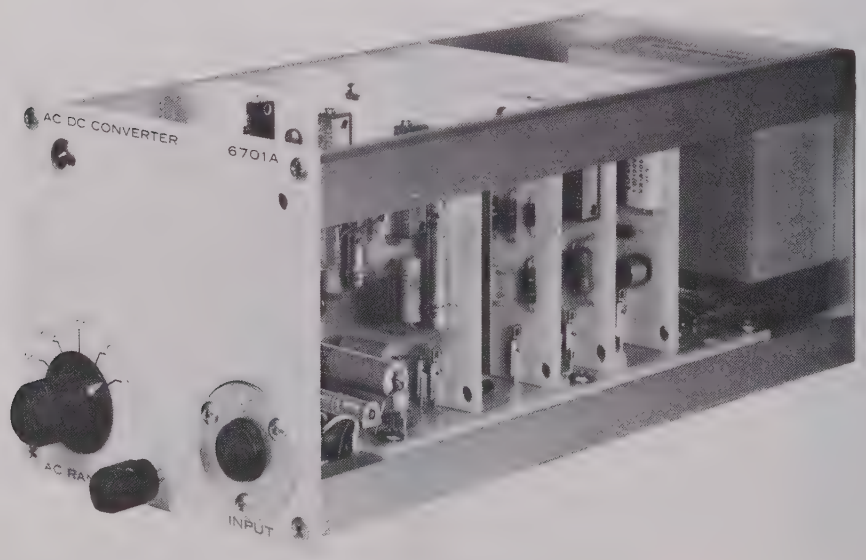


Figure 8-2. AC-DC Converter.

DC PRE-AMPLIFIER Models 6801A and 6802A

These chopper stabilized DC pre-amplifiers extend the use of Series 7000A instruments to 0.1 microvolt. Using an all solid state circuit, including silicon transistors, they allow microvolt sensitivity but with excellent stability and immunity to temperature effects.

Gain: 6801A: X10, X100.
6802A: X100, X1000.

Combined Accuracy: X10 and X100 gain: 0.02% of reading, or ±1 digit or ±2 microvolts, whichever is greatest.
X1000 gain (Model 6802A only): 0.03% of reading or ±2 microvolts, whichever is greater.

Drift: Less than ±5 microvolts for 7 days.

Input Resistance: 1000 megohms on X10, 100 megohms on X100, 10 megohms on X1000.

Common Mode Rejection: With X100 gain, 140 db at DC and 130 db at 60 cps for Series 7000A instruments. Input may be floated to 200V DC or peak AC.

Weight: 5 lbs. net, 7 1/2 lbs. shipping.

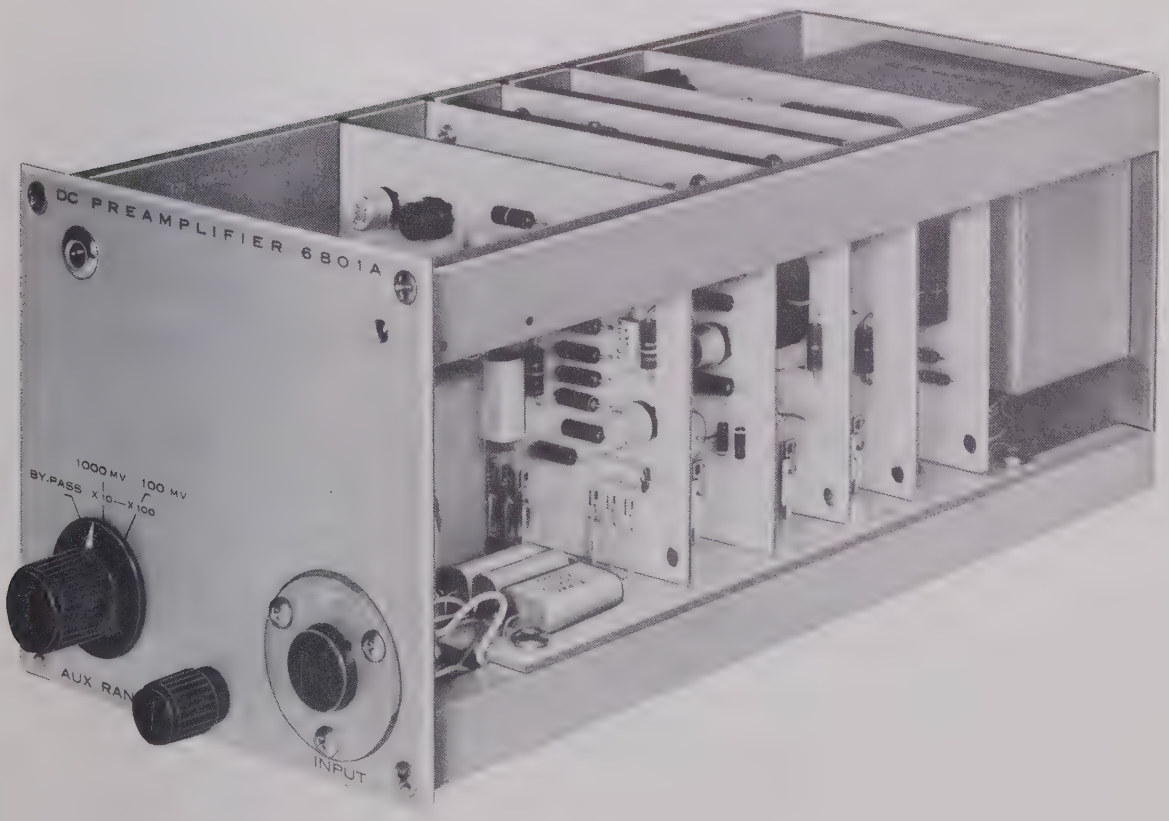


Figure 8-3. DC Pre-amplifier.

OHMS-DC CONVERTER Models 6910A and 6911A

When used with CIMRON meters, the ohmmeter modules generate a constant current in decade ranges which is impressed across the unknown resistance. The resulting voltage is precisely measured by the digital voltmeter. The Model 6911A has true four-wire input. The Model 6910A has a two-wire input: however, it provides true compensation for fixed lead resistance up to 2 ohms.

Ranges: 6910A and 6911A: 0 to 9.9999 megohms in five decade ranges with full-scale readings of 999.99Ω, 9.9999KΩ, 99.999KΩ, Currents through unknown resistance on these ranges are 10 ma, 1 ma, and 100, 10 and 1 microampere respectively. The RANGE switch includes a "DC" position which bypasses the converter for normal DVM usage.

Combined Accuracy: 6910A: 1000Ω range: ±0.05% of reading or ±0.005% of full scale or ±2 digits whichever is greatest. 10K, 100K and 1MΩ ranges: ±0.05% of reading or 0.005% of full scale or ±1 digit whichever is greatest. 10MΩ range: 0.1% of reading or ±0.01% of full scale whichever is greater. 6911A: 1000 ohm, 10KΩ and 100KΩ ranges: ±0.03% of reading or ±0.003% of full scale or ±1 digit, whichever
1MΩ range: ±0.05% of reading or ±0.05% of full scale or ±1 digit, whichever is greatest. 10 MΩ range: ±0.1% of reading or ±0.01% of full scale, whichever is greater.

Stability: 0.01% for at least 30 days.

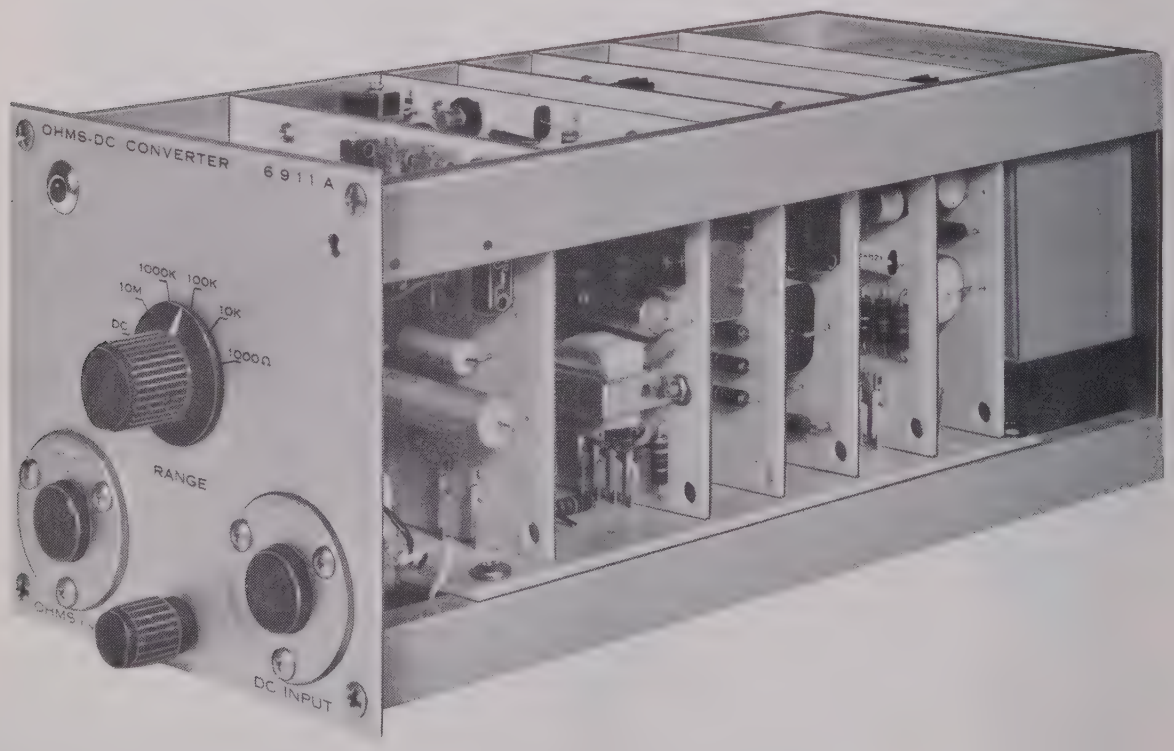


Figure 8-4. Ohms-DC Converter.

DC STABLE SOURCE Model 6950A

When used with CIMRON meters, the Model 6950A becomes a precision voltage standard acquiring the voltage accuracy of the digital voltmeter. Vernier voltage controls allow adjustment of the output voltage to any exact value within its output capabilities. The high stability and low noise exhibited by this supply adapt it for use in calibration and testing in a variety of applications.

Voltage Range:	0 to 100 volts.
Voltage Stability:	0.05% or 4 millivolts for 8 hours, 0.01% or 1 millivolt for 1 hour after 30 minute warm-up and under constant ambient conditions.
Current:	15 milliamps maximum.
Power Requirements:	115V ±10%, 60 cps.
Weight:	5 lbs, net, 7 1/2 lbs. shipping.

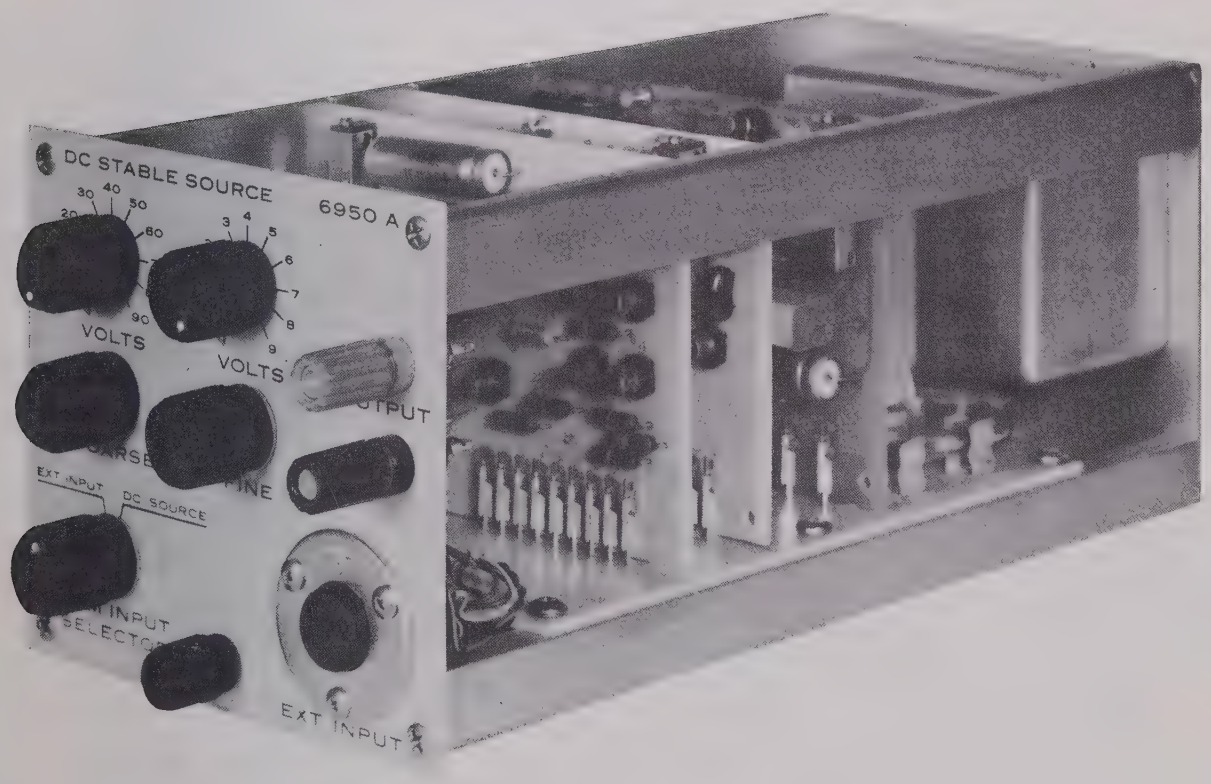


Figure 8-5. DC Stable Source.

HIGH VOLTAGE MODULE Model 6930A

Used in any Series 7000A CIMRON meter for voltage measurements to 7,500V DC. A special high voltage connector accepts the high voltage input with a standard input connector for normal low voltage measurement. A front panel switch will select "NORMAL" or "KC" operation.

Input Resistance: 100 megohms.

Accuracy: 0.1% or ±1 digit.

Long Term Stability: 0.05%.

Calibration Control: Setability to 0.01%.

SPECIAL PLUG-IN MODULES

Special plug-in modules, including variations of standard modules, are continuously being engineered to meet specific requirements. Your inquiry is invited.

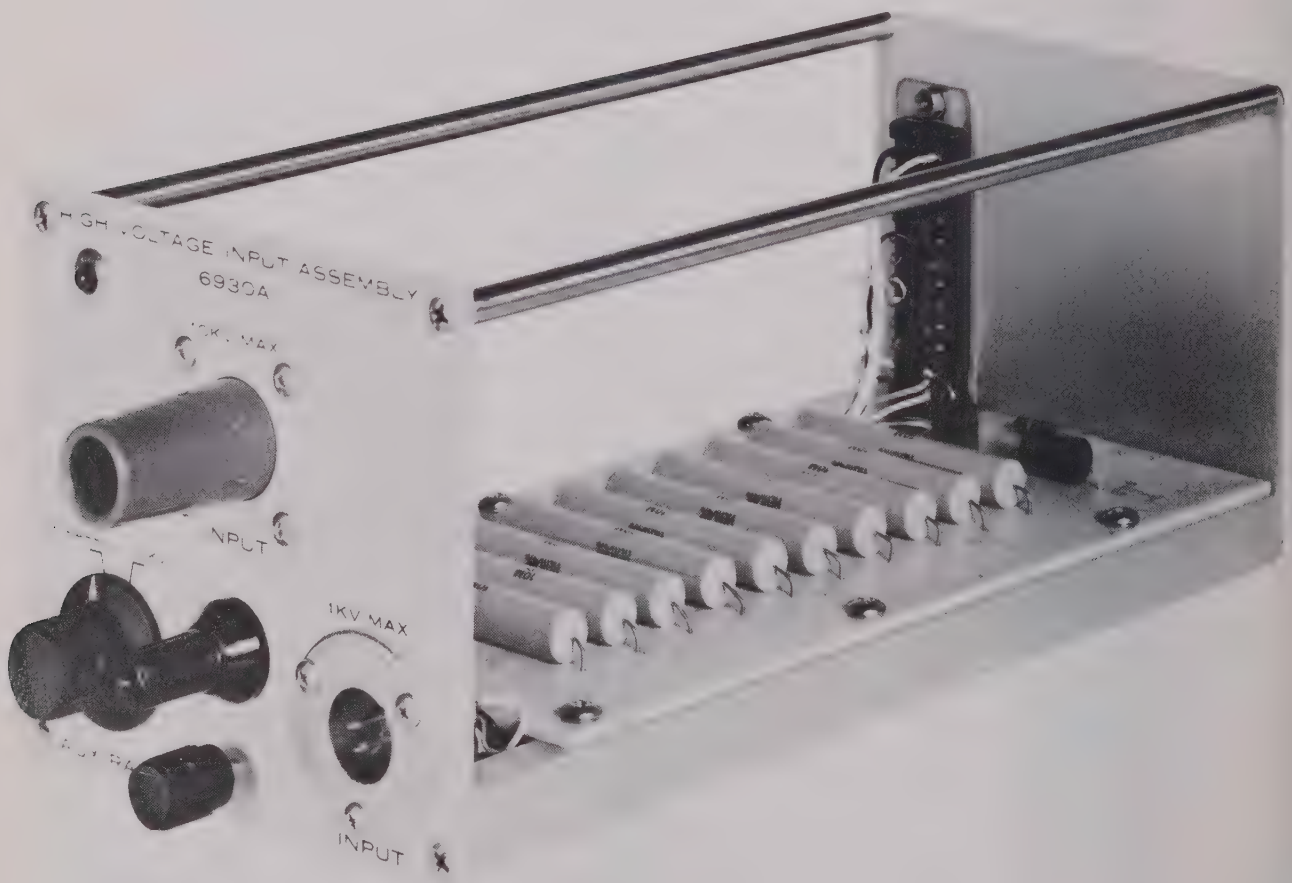


Figure 8-6. High Voltage Module.

APPENDIX

MODEL NO._____ SERIAL NO._____

IMPORTANT

Include the instrument model number and the above serial number in any correspondence regarding this instrument. The above serial number must match the instrument serial number if parts are to be ordered from the manual. Your help in this will enable us to answer your inquiries and fill your order with the least possible delay.

WARRANTY

All CIMRON instruments are fully warranted to be free from defects in material and workmanship for a period of one year as per CIMRON's standard terms and conditions of sale. This warranty does not, however, cover tubes, transistors, choppers, fuses and/or batteries. Mechanical stepping switches are guaranteed for ninety days provided they have been lubricated in accordance with manufacturers instructions.

Should replacement parts be required, whether at no charge under warranty or at established net prices, notify us promptly, including sufficient details to identify the required parts. We will ship them (shipping charges collect) as soon as possible, usually within twenty-four hours.

CIMRON reserves the right to adjust the prices and make design modifications without notice.

CLAIM FOR DAMAGE IN SHIPMENT

The instrument should be tested as soon as it is received. If it does not operate or is damaged, a claim should be filed with the carrier. A copy of the claim should be sent to CIMRON. Upon receipt of the claim we will advise you of the disposition to be made of the instrument and arrangements will be made for repair or replacement. Do not return an instrument to CIMRON without prior approval.

The above statements and warranty constitute a part of our Standard Terms and Conditions of Sale as published in our order acknowledgment which is CIMRON's Warranty in its entirety.

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